5-6115-357-15

TM 5-6115-357-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DIRECT AND GENERAL SUPPORT, AND DEPOT MAINTENANCE MANUAL

GENERATOR SET, DIESEL ENGINE: WHEEL MOUNTED, LIQUID COOLED, 15 KW, 400 HERTZ, AC, 3 PHASE, 4 WIRE, 120/208 V; NON-WINTERIZED, SPECIAL PURPOSE (MODEL SP-HF-15) FSN 6115-089-5099

This reprint includes all changes in effect at the time of publication; changes 1 through 4.

HEADQUARTERS, DEPARTMENT OF THE ARMY

DECEMBER 1967

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TM 5-6115-357-15
C 1

CHANGE
No. 1

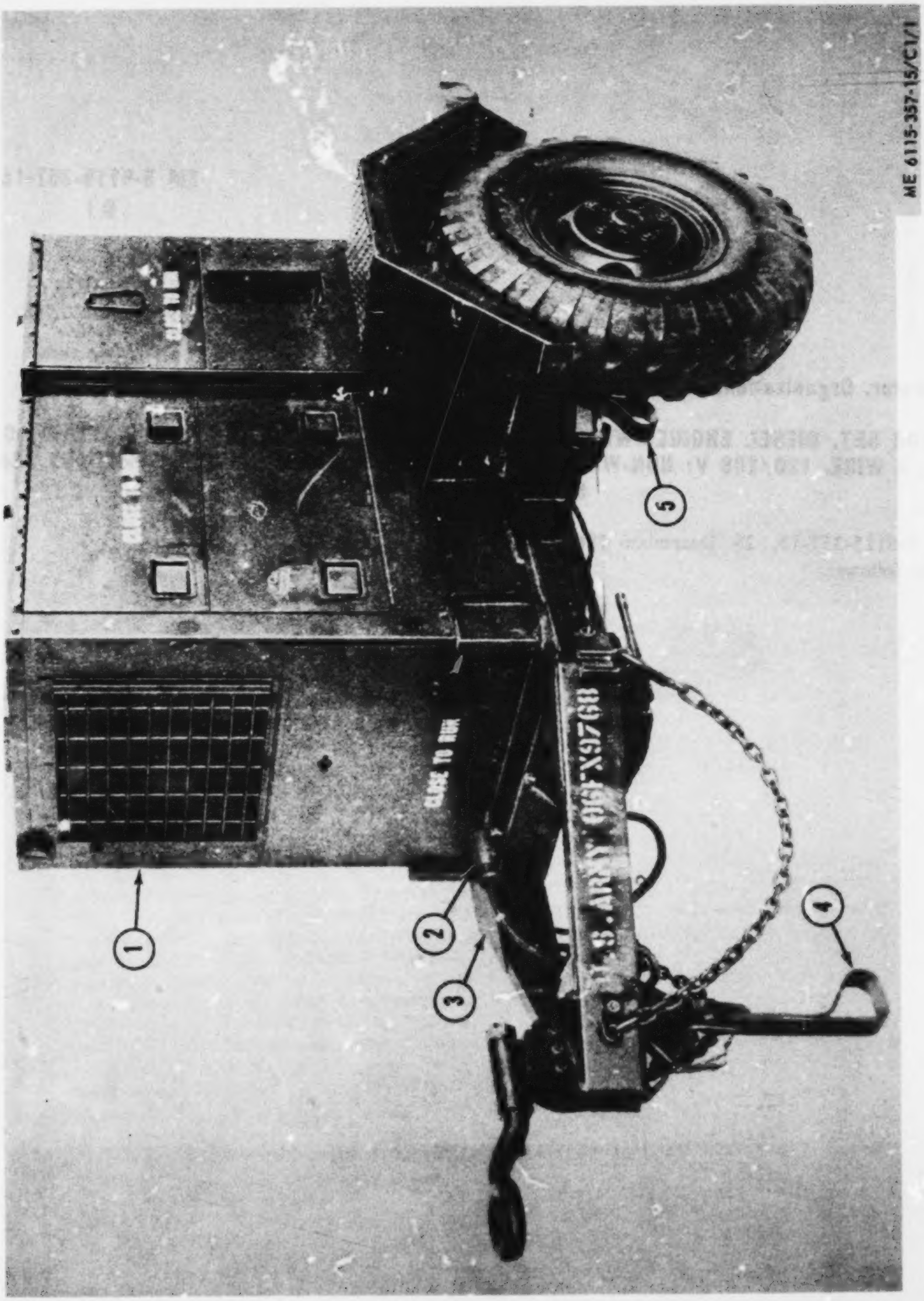
HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *9 August 1968*

Operator, Organizational, Direct and General Support, and Depot Maintenance Manual

GENERATOR SET, DIESEL ENGINE; WHEEL MOUNTED, LIQUID COOLED, 15 KW, 400 HERTZ, AC, 3 PHASE, 4 WIRE, 120/208 V; NON-WINTERIZED, SPECIAL PURPOSE (MODEL SP-HF-15) FSN 6115-089-5099

TM 5-6115-357-15, 28 December 1967, is changed as follows:

Page 4. Figure 1 is superseded as follows:


ME 6115-357-15/C1/1
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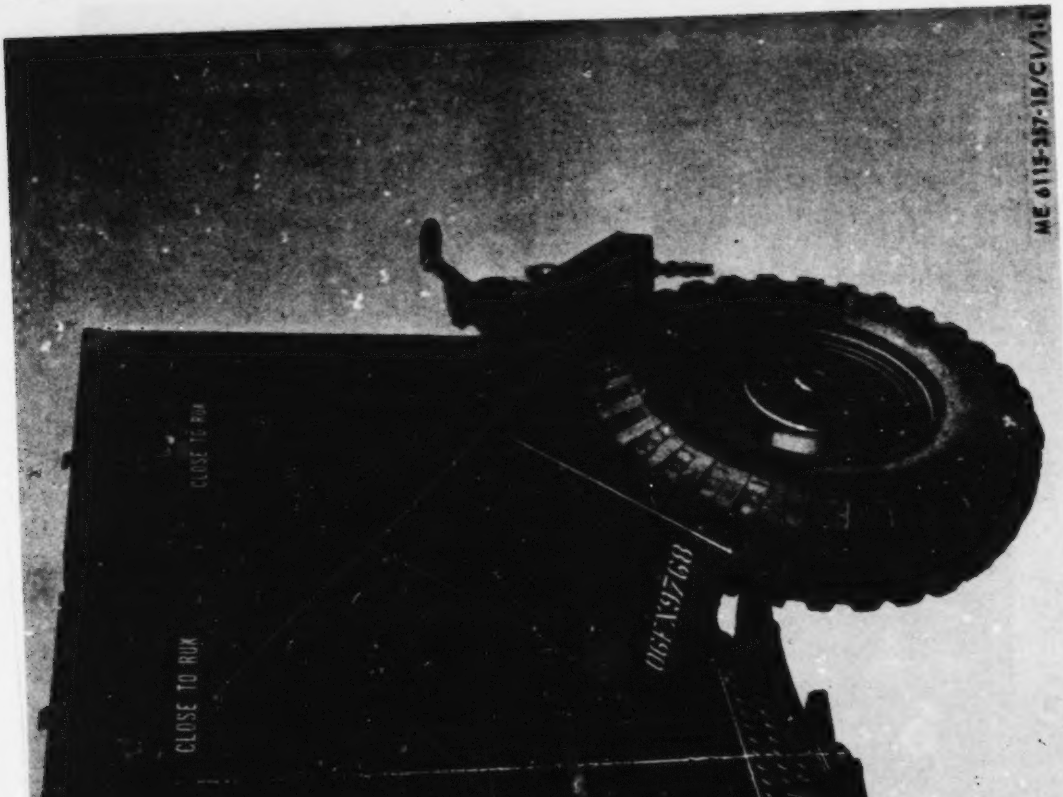
CLOSE TO RUN

1 Generator set assembly
2 Wiring harness
3 Trailer assembly
4 Front landing leg
5 Rear landing leg

Figure 1. Generator set, right front, three-quarter view.

Figure 1.1 is added as follows:


ME 6115-357-15/C1/1.1
CLOSE TO RUN
CLOSE TO RUN
OPEN OPEN
TO RUN TO RUN
06FX9768
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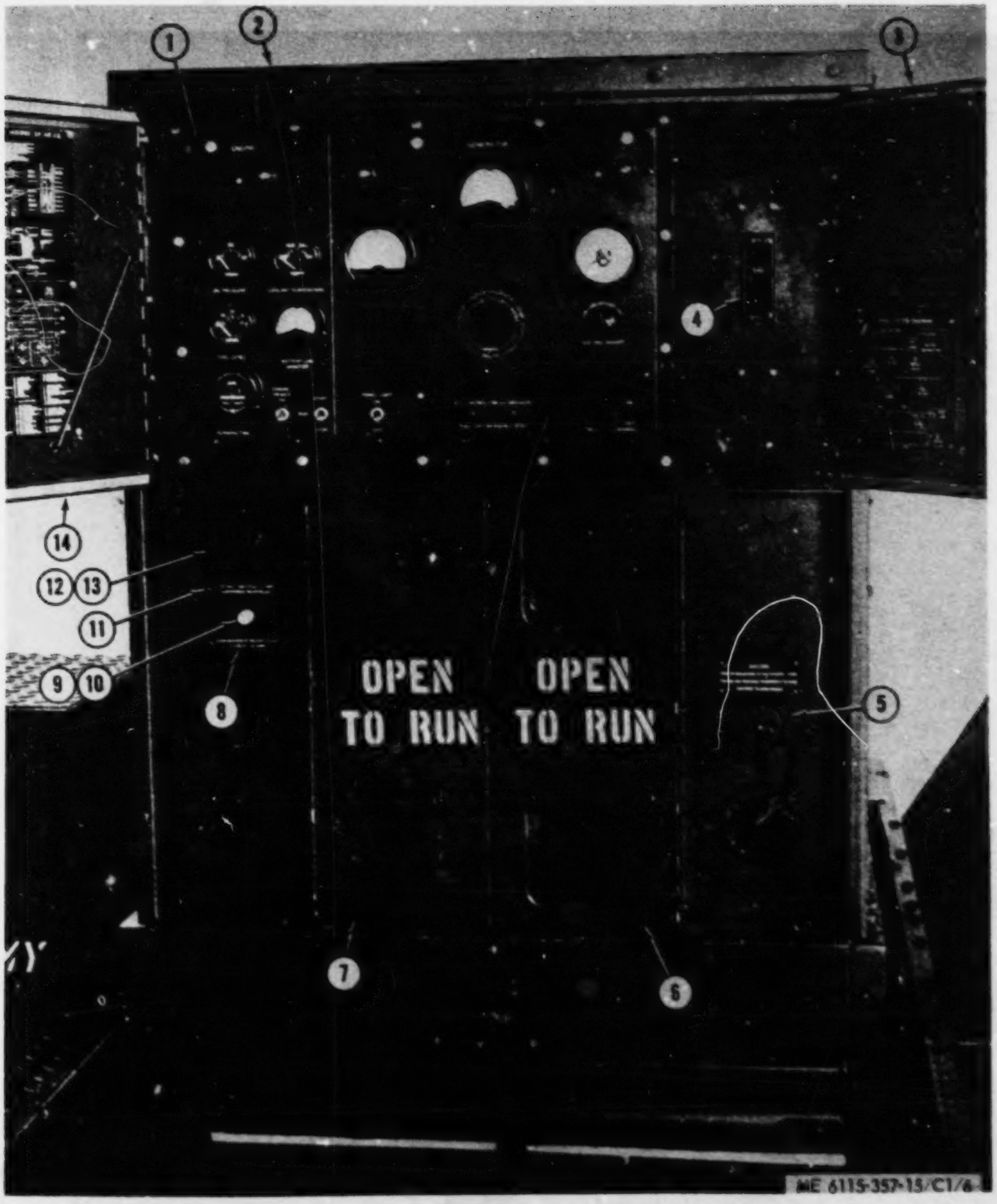
1 Pintle hook assembly 2 Rear landing leg

Figure 1.1. Generator set, right rear, three-quarter view.

Page 12. Figure 6 is superseded as follows: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OPEN TO RUN
OPEN TO RUN
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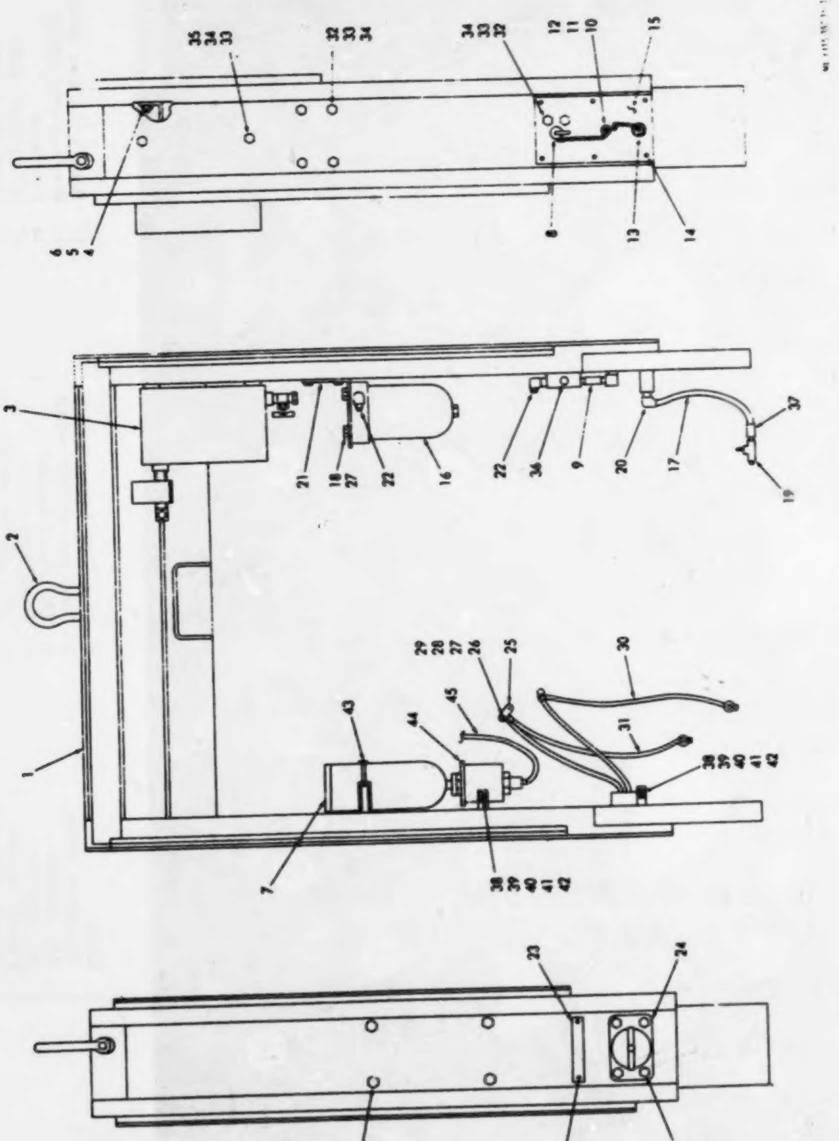
ME 6115-357-15/C1/6

1 Control box assembly
2 Rear frame weldment
3 Rear door, upper-RH
4 Circuit breaker
5 Receptacle
6 Rear door, lower-RH
7 Rear door, lower-LH
8 Plate, identification
9 Fuse holder
10 Fuse
11 Plate, identification
12 Cover
13 Receptacle
14 Rear door, upper-LH

Figure 6. Rear frame with control box.

Page 19. **Figure 12 is superseded as follows:**



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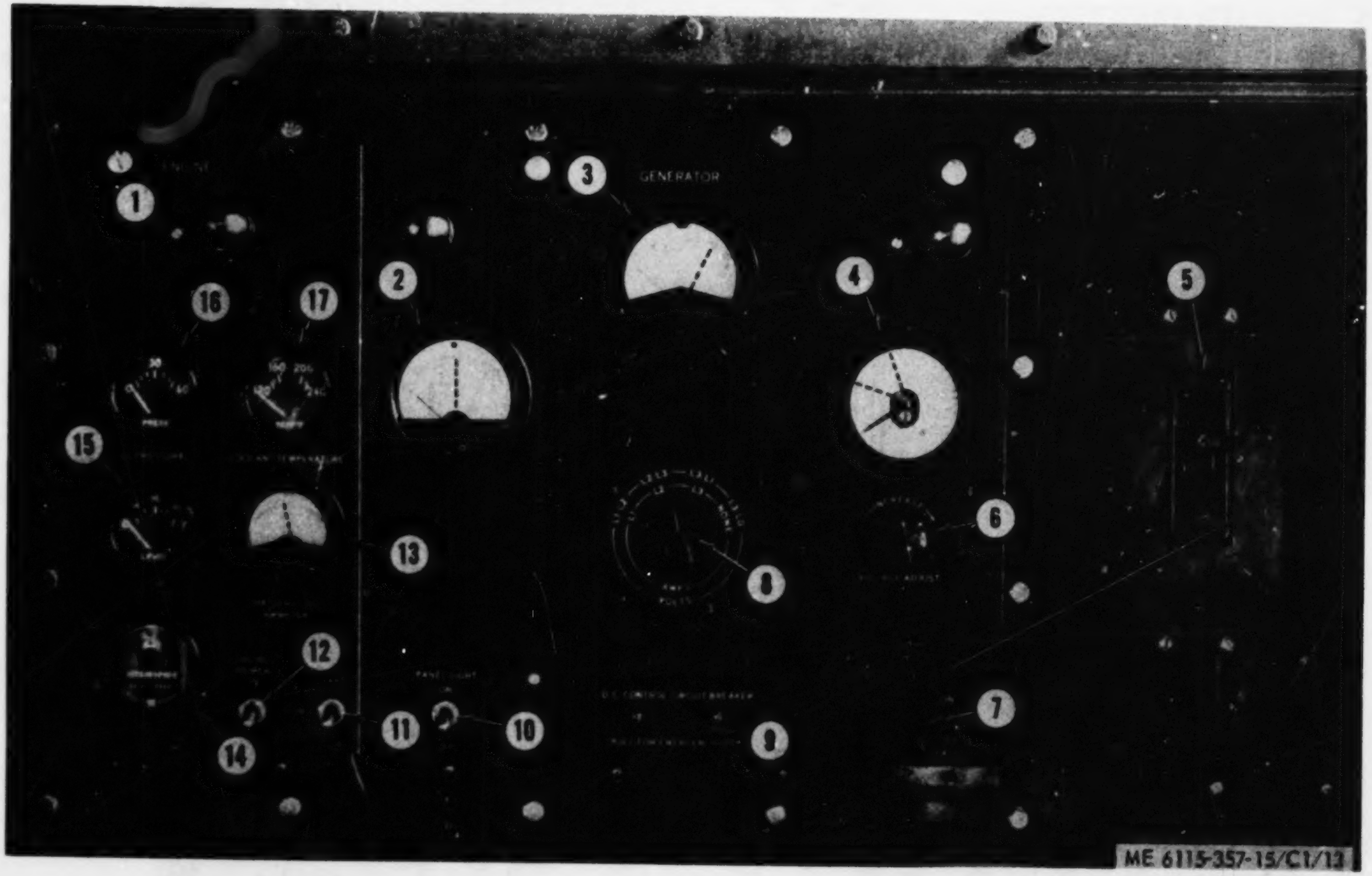
1	Center frame
2	Clevis, lifting
3	Tank assembly
4	Screw
5	Washer
6	Nut
7	Starting aid
8	Cock
9	Nipple
10	Coupling
11	Cap
12	Elbow
13	Drain plug assembly
14	Screw
15	Plate
16	Fuel filter
17	Hose
18	Capscrew
19	Cock
20	Elbow
21	Bracket
22	Elbow
23	Plate
24	Receptacle
25	Ground strip
26	Screw
27	Washer
28	Washer
29	Nut
30	Cable
31	Cable
32	Screw
33	Washer
34	Nut
35	Screw
36	Connector
37	Connector
38	Bracket
39	Clamp
40	Screw
41	Washer
42	Nut
43	Bracket
44	Valve
45	Tube

Figure 12. Center frame assembly.

Page 23. Figure 13 is superseded as follows: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GENERATOR
ME 6115-357-15/C1/13

1	Lamp	7	Protection bypass switch	13	Battery charging ammeter
2	Frequency meter	8	Volt-amp selector switch	14	Running time meter
3	AC ammeter	9	DC circuit breaker	15	Fuel gage
4	AC voltmeter	10	Panel light switch	16	Oil pressure gage
5	Circuit breaker	11	Start-stop-run switch	17	Temperature gage
6	Voltage adjustment	12	Engine primer switch		

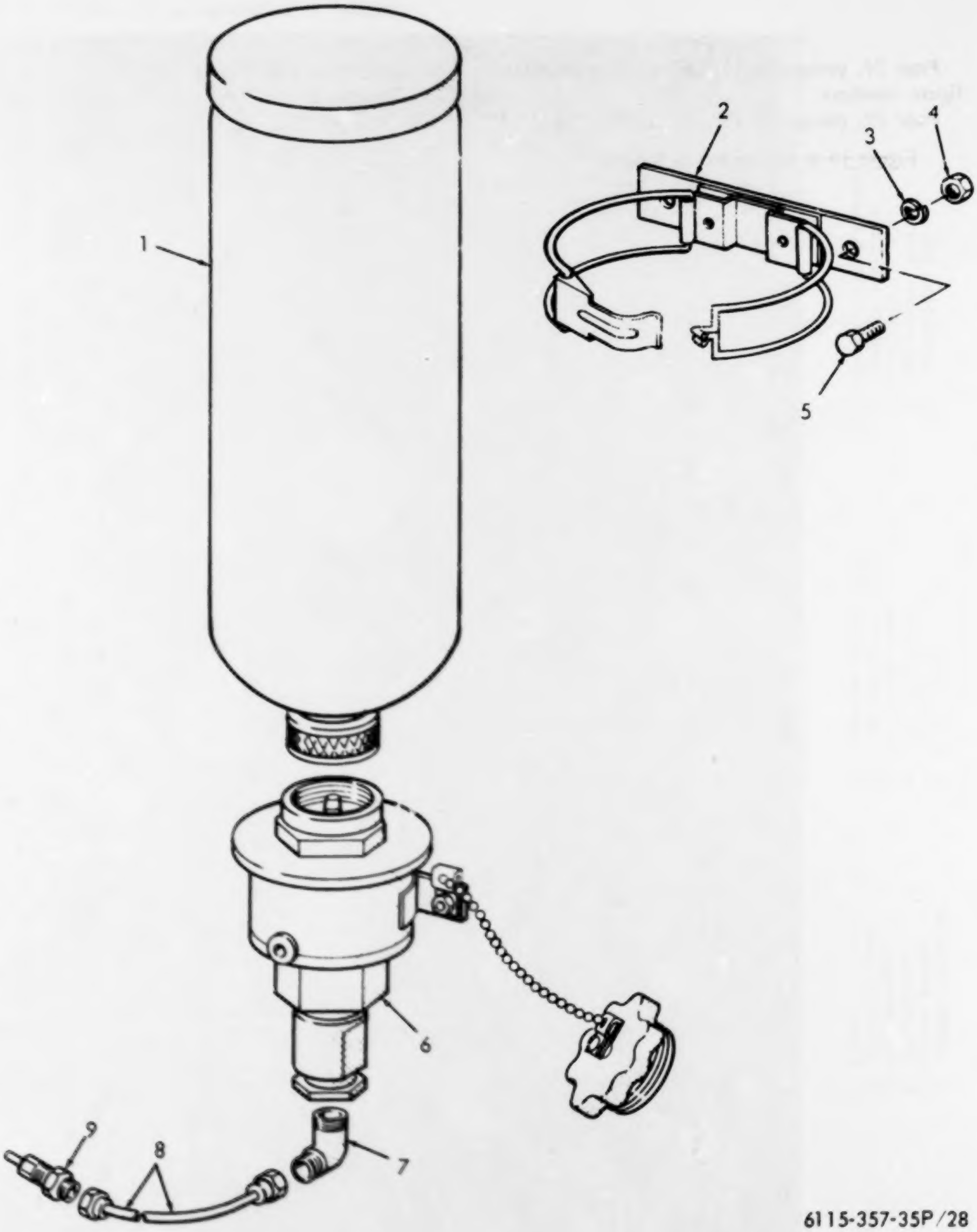
Figure 13. Control box assembly.

Page 24, paragraph 11. Delete all reference to figure numbers.

Page 25, paragraph 13*c*. In heading, "+32° F" is changed to read "Below +40° F".

Paragraph 13*c*(1). Line 2, change "(9, fig. 13)" to read "(12, fig. 13)"

Figure 14 is superseded as follows: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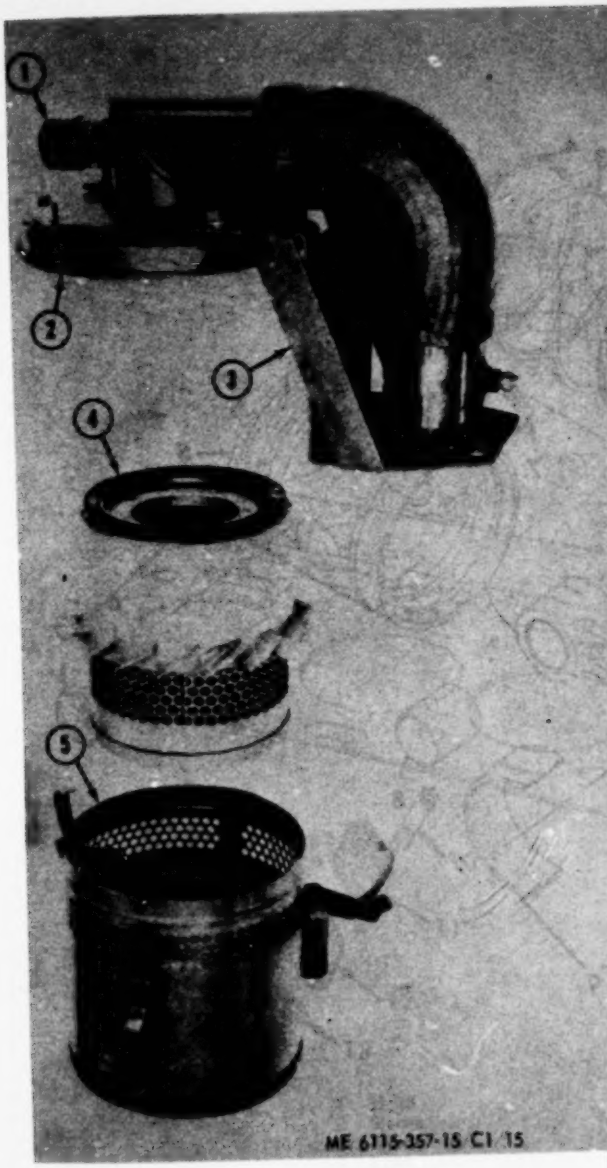
6115-357-35P/28

1	Tank	6	Starting aid
2	Bracket	7	Elbow
3	Washer	8	Line
4	Nut	9	Fitting
5	Screw		

Figure 14. Ether primer.

Page 26. Figure 15 is superseded as follows:



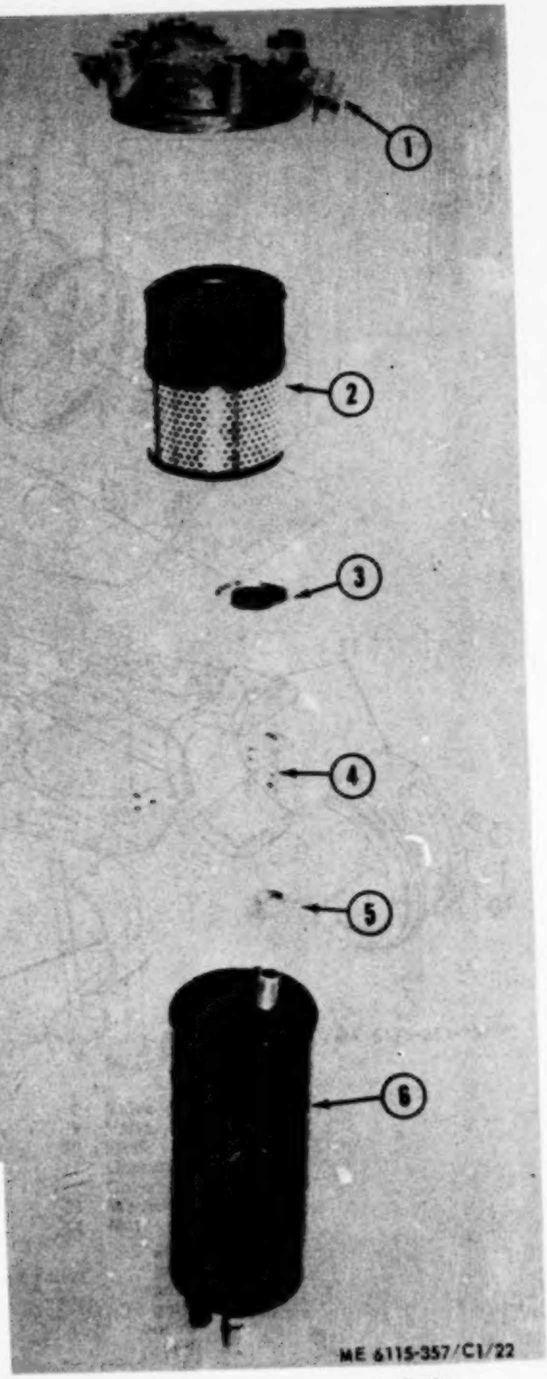
1 Cap
2 Cover assembly
3 Bracket
4 Element assembly
5 Body assembly

Figure 15. Air cleaner.

Page 31. Paragraph 17*p* is changed to include the following:

Probable cause	*Possible remedy*
Defective stator	Replace stator
Defective rotor	Replace rotor
Overload	Reduce load

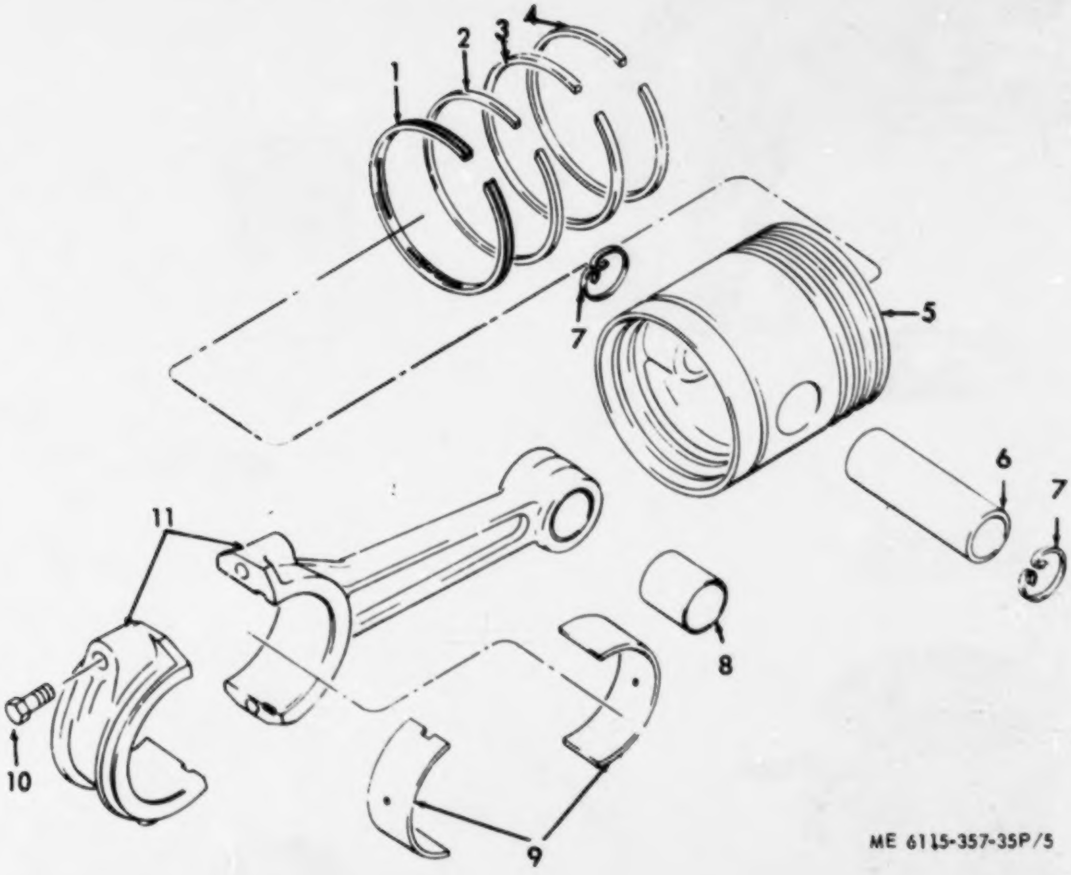
Page 37. Figure 22 is superseded as follows:



1 Head assembly
2 Filter assembly
3 Plate
4 Spring
5 Seat
6 Body assembly

Figure 22. Water separator.

Page 56. Figure 34 is superseded as follows:



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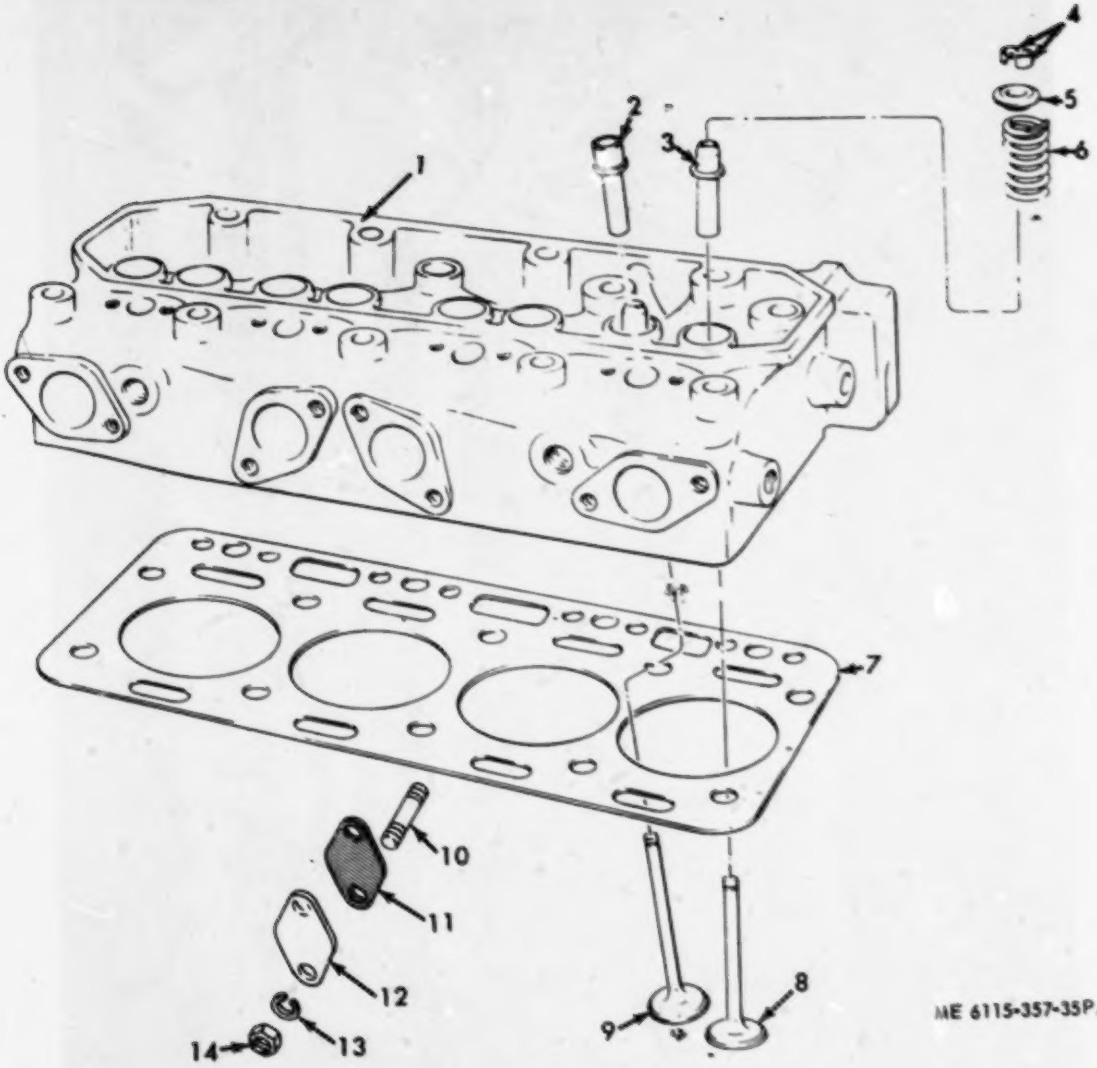
ME 6115-357-35P/5

1 Ring
2 Ring
3 Ring
4 Ring
5 Piston
6 Pin
7 Retaining ring
8 Bearing
9 Bearing
10 Bolt
11 Rod assembly

Figure 34. Piston and connecting rod.

Page 63. Figure 37 is superseded as follows.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ME 6115-357-35P/2

1	Head
2	Sleeve
3	Guide
4	Lock
5	Seat
6	Spring
7	Gasket
8	Valve
9	Valve
10	Stud
11	Gasket
12	Cover
13	Washer
14	Nut

Figure 37. Cylinder head and valves.

Page 73, paragraph 22e. In line 1, "(fig. 40)" is changed to read "(fig. 40A)".

Page 74. Figure 40A is added after paragraph 22*e*.

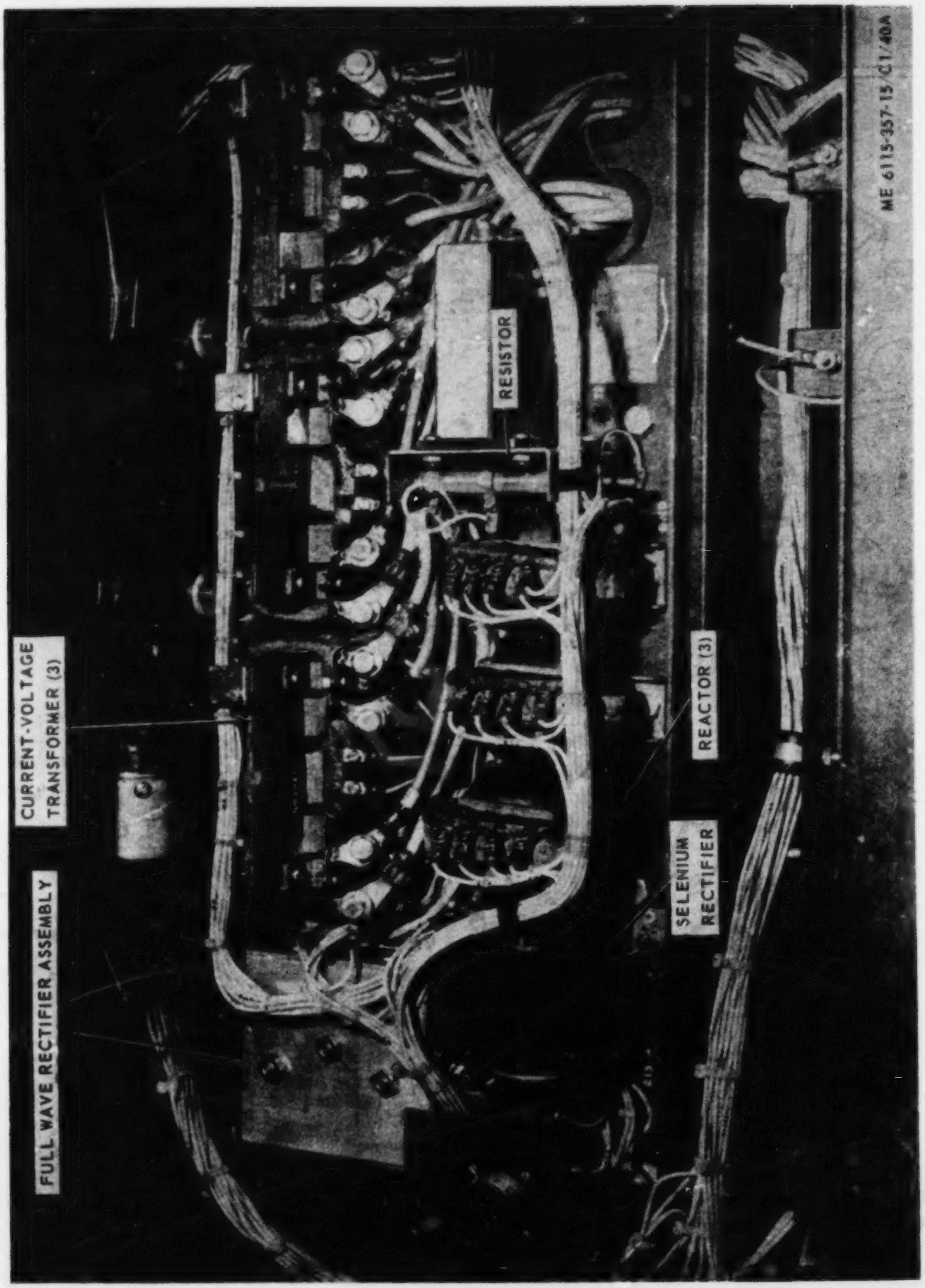
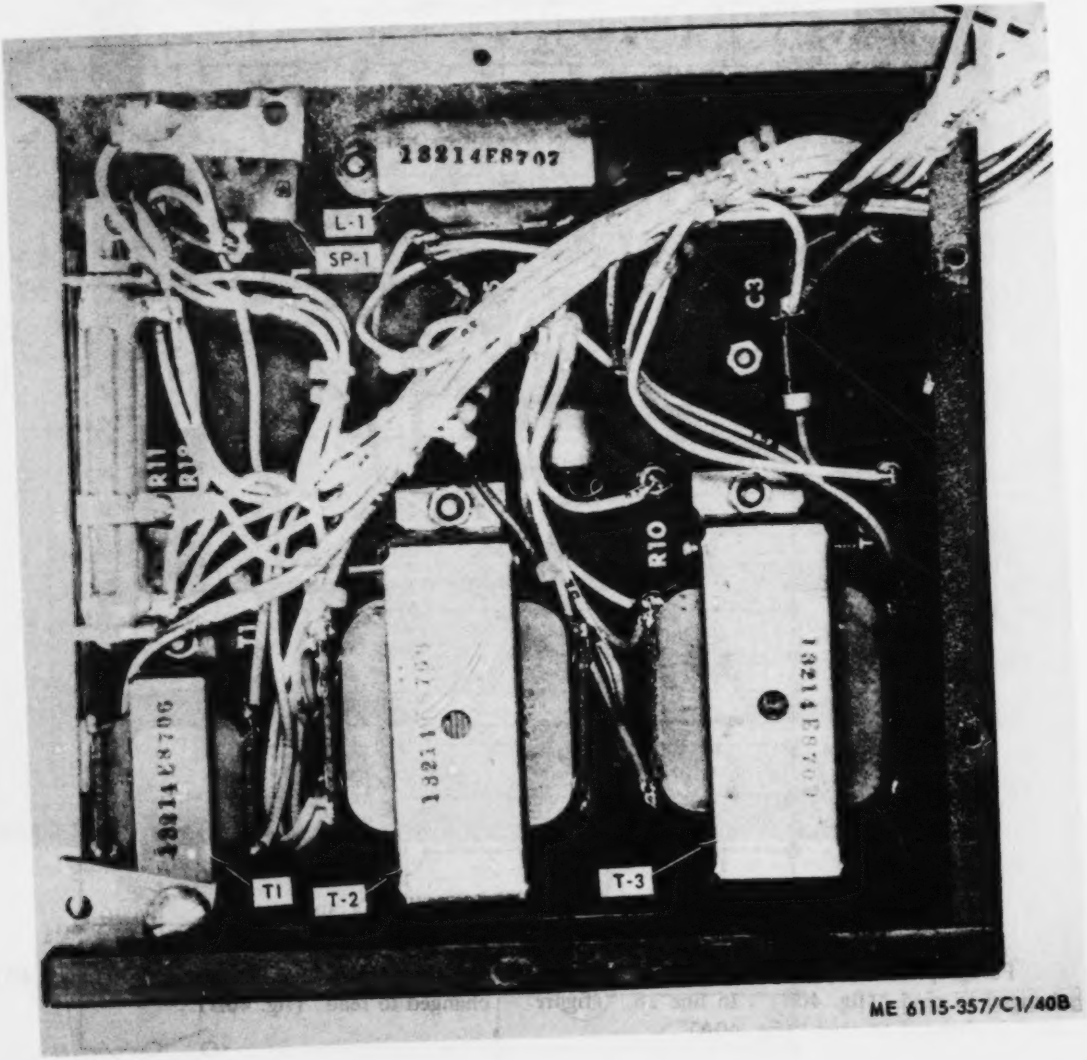

CURRENT-VOLTAGE TRANSFORMER (3)
FULL WAVE RECTIFIER ASSEMBLY
RESISTOR
REACTOR (3)
SELENIUM RECTIFIER
ME 6115-357-15/C1/40A

Figure 40A. Exciter.

Caption for figure located in back of manual is changed from "Figure 40" to "figure 40D".

Figure 40B is added after paragraph 22*h*.

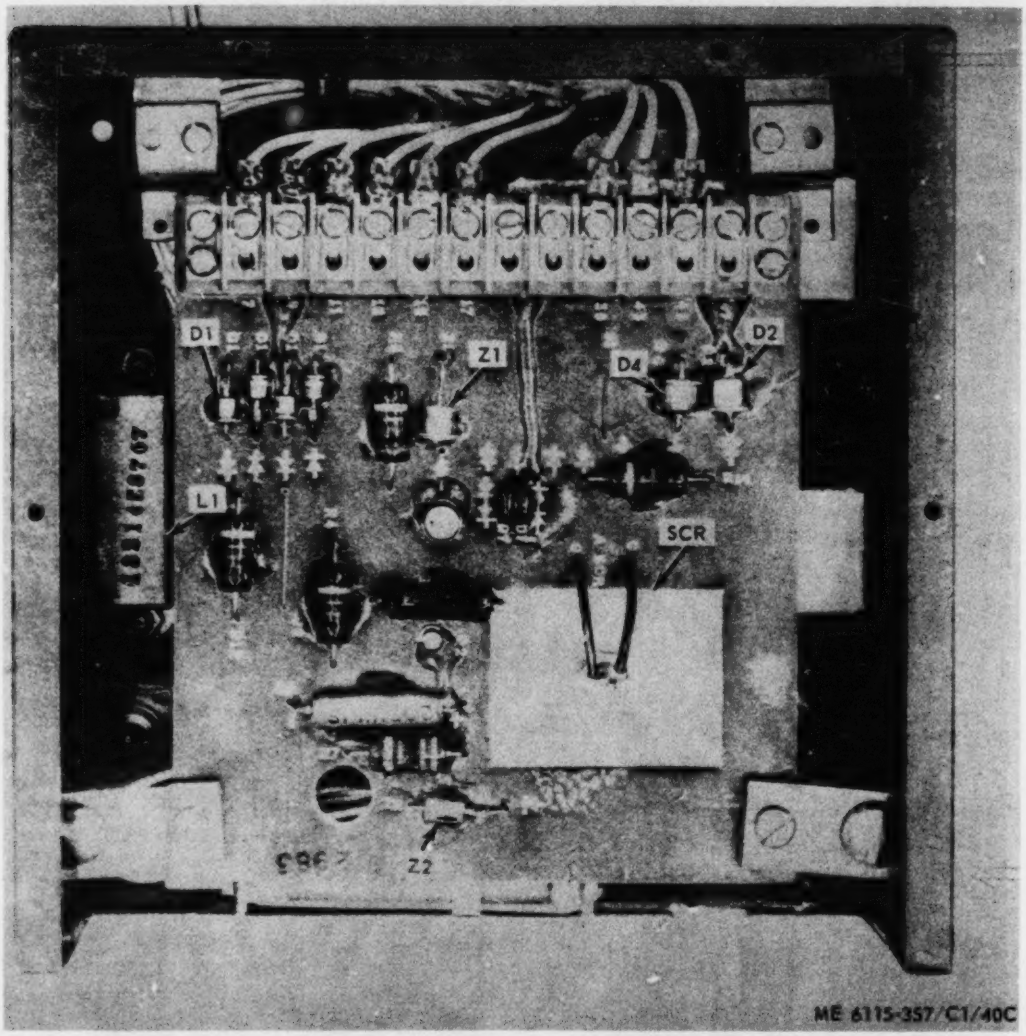
Paragraph 22*f*. In line 6, "(figure 40)" is changed to read "(fig. 40D)".


13214E8707
L-1
SP-1
C3
R11
R10
T1
T-2
T-3
13214E8706

ME 6115-357/C1/40B

Figure 40B. Regulator, less cover and printed circuit board.

Figure 40C is added after paragraph 22*h*.



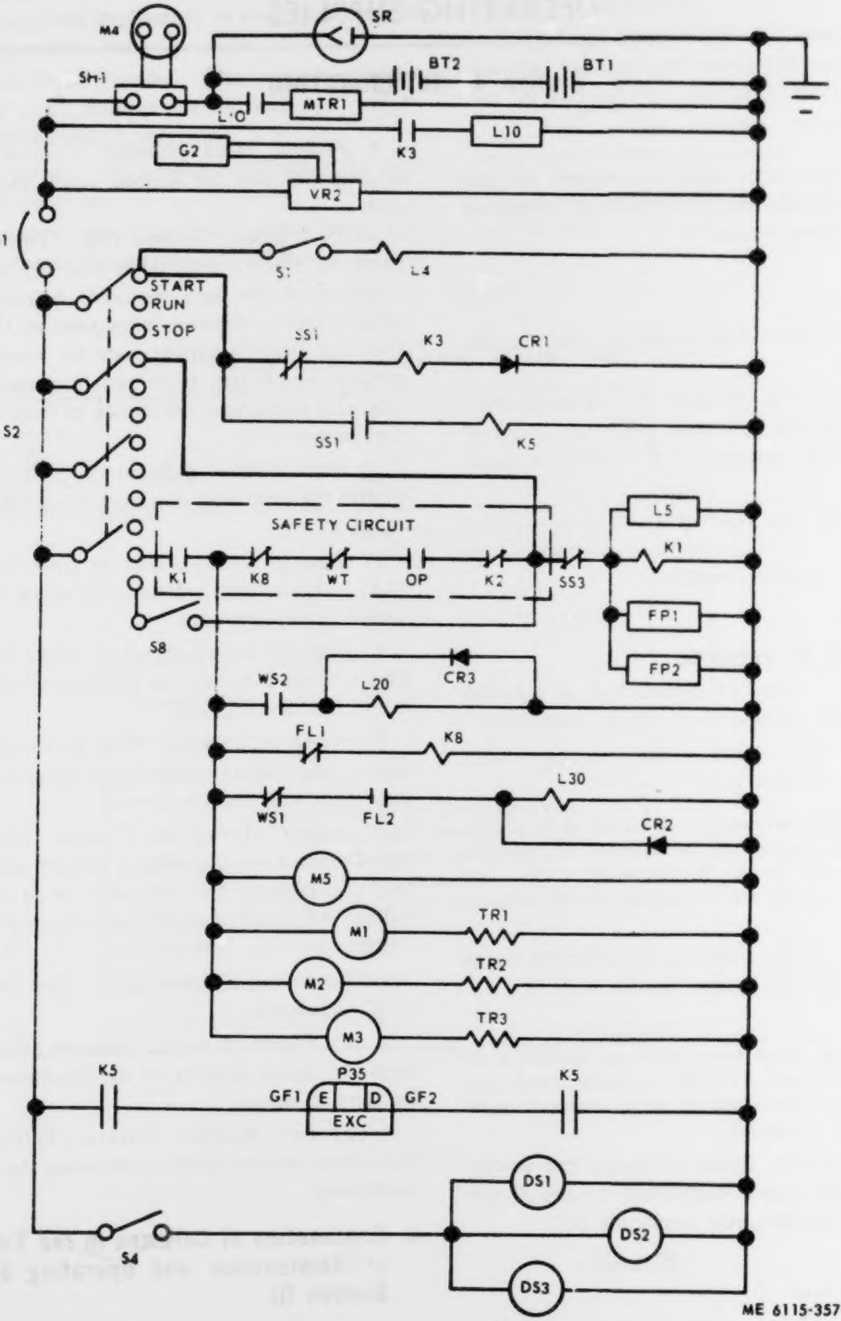
ME 6115-357/C1/40C

Figure 40C. Printed circuit board, regulator.

Paragraph 22*i*. In line 1, "(figure 40)" is changed to read "(fig. 40B)". In line 18, "(figure 40)" is changed to read "(fig. 40A)".

Paragraph 22*m*. In heading, "(figure 40)" is changed to read "(fig. 40B)".

Page 102. Figure 58(2) is superseded as follows:


M4
SR
SH-1
BT2
BT1
L-O
MTR1
K3
L10
G2
VR2
CB1
S1
L4
START
RUN
STOP
SS1
K3
CR1
SS1
K5
S2
SAFETY CIRCUIT
L5
K1
K8
WT
OP
K2
SS3
K1
FP1
FP2
S8
CR3
WS2
L20
FL1
K8
L30
WS1
FL2
CR2
M5
M1
TR1
M2
TR2
M3
TR3
K5
P35
GF1
E
D
GF2
EXC
K5
DS1
DS2
DS3
S4

ME 6115-357-15/58

Figure 58(2).—Continued.

Page 121 thru 123. Sections I and II of Appendix C are superseded as follows:

APPENDIX C

BASIC ISSUE ITEMS LIST AND MAINTENANCE AND OPERATING SUPPLIES

Section I. INTRODUCTION

1. Scope

This appendix lists items which accompany the generator set or are required for installation, operation. or operator's maintenance.

2. General

This Basic Issue Items List is divided into the following sections:

a. Basic Issue Items—Section II. A list of items which accompany the generator set or are required for the installation, operation, or operator's maintenance.

b. Maintenance and Operating Supplies—Section III. A listing of maintenance and operating supplies required for initial operation.

3. Explanation of Columns

The following provides an explanation of columns in the tabular list of basic issue items, section II.

a. Source, Maintenance, and Recoverability Codes (SMR) Column (1).

Note. Common hardware items known to be readily available in Army supply will be assigned Maintenance Codes only. Source Codes, Recoverability Codes, and Quantity Authorized will not be assigned to this category of items.

(1) Source Code, indicates the selection status and source for the listed item. Source code is

Code	*Explanation*
P	Applied to repair parts which are stocked in or supplied from GSA/DSA or Army supply system, and authorized for use at indicated maintenance categories.

(2) Maintenance Code, indicates the lowest category of maintenance authorized to install the listed item. The maintenance level code is:

Code	*Explanation*
C	Operator/crew.

(3) Recoverability Code, indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are expendable.

b. Federal Stock Number, Column (2). This column indicates the Federal stock number for the item.

c. Description, Column (3). This column indicates the Federal item name and any additional description of the item required. A part number or other reference number is followed by the applicable five-digit Federal supply code for manufacturers in parentheses. Repair parts quantities included in kits, sets, and assemblies are shown in front of the repair part name.

d. Unit of Issue, Column (4). This column indicates the unit used as a basis for issue, e.g., ea, pr, ft, yd, etc.

e. Quantity Incorporated in Unit Pack, Column (5). This column indicates the actual quantity contained in the unit pack.

f. Quantity Incorporated in Unit, Column (6). This column indicates the quantity of the item used in the functional group.

g. Quantity Furnished With Equipment, Column (7). This column indicates the quantity of an item furnished with the equipment.

h. Quantity Authorized, Column (8). This column indicates the quantity of an item authorized the operator/crew to have on hand or to obtain as required. As required items are indicated with an asterisk.

i. Illustration, Column (9). This column is divided as follows:

(1) *Figure Number, column (9)(a).* Indicates the figure number of the illustration in which the item is shown.

(2) *Item Number, column (9)(b).* Indicates the callout number used to reference the item in the illustration.

4. Explanation of Columns in the Tabular List of Maintenance and Operating Supplies—Section III

a. Item. This column contains numerical sequenced item numbers, assigned to each component application.

b. Component Application. This column identifies the component application of each maintenance or operating supply item.

c. Federal Stock Number. This column indicates the Federal stock number for the item and will be used for requisitioning purposes.

d. Description. This column indicates the item and brief description.

e. Quantity Required for Initial Operation. This column indicates the quantity of each maintenance or operating supply item required for initial operation of the equipment.

f. Quantity Required for 8 Hours Operation. This column indicates the estimated quantities required for an average eight hours of operation.

g. Notes. This column indicates informative notes keyed to data appearing in a preceding column.

Page 124, section III. In column 5, change "18.6 gal." to read "14.0 gal.".

Section II — BASIC ISSUE ITEMS LIST

(1) Source, maint, and recov code			(2) Federal stock No.	(3) Description	(4) Unit of issue	(5) Qty inc in unit pack	(6) Qty inc in unit	(7) Qty furn with equip	(8) Qty auth	(9) Illustration	
(A) S	(B) M	(C) R								(A) Fig No.	(B) Item No.
				GROUP 32 BASIC ISSUE ITEMS, TROOP INSTALLED							
				3200 BASIC ISSUE ITEMS, TROOP INSTALLED OR AUTHORIZED							
P	C		2910-066-1235	Adapter, Fuel	EA			1	1		
P	C		7510-889-3494	Binder, Log Book	EA			1	1		
P	C		7520-559-9618	Case, Manual	EA			1	1		
P	C		5935-258-9156	Connector, Plug	EA			1	1		
				Department of the Army Operator, Organizational, Direct and General Support, and Depot Maintenance Manual TM 5-6115-357 15	EA			1	1		
P	C		4210-55-8837	Extinguisher, Fire	EA			1	1		
P	C		4720-939-7139	Hose, Auxiliary Fuel	EA			1	1		
P	C		5975-878-3791	Rod, Ground	EA			1	1		

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12-25 (qty rqr block no. 734) Section IV organizational maintenance requirements for Generator Set 15 KW 60 Cycle.

Changes in force: C 1 and C 2

TM 5-6115-357-15
C 2

Change No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., *31 August 1973*

Operator, Organizational, Direct Support and General Support, and Depot Maintenance Manual GENERATOR SET, DIESEL ENGINE: WHEEL MOUNTED; LIQUID COOLED; 15 KW, 400 HERTZ, AC, 3 PHASE, 4 WIRE, 120/208V; NON-WINTERIZED; SPECIAL PURPOSE (MODEL SP-HF-15) FSN 6115-089-5099

TM 5-6115-357-15, 28 December 1967, is changed as follows:

Page 3. Paragraph 1.*b*. The third sentence is rescinded, "Appendix C gives . . . of this equipment."

Page 111. Appendix A is superseded as follows:

APPENDIX A
REFERENCES

1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire Extinguishers Approved for Army Users.

2. Lubrication

C9100-IL	FSC Group 91 Fuels, Lubricants, Oils, and Waxes
LO 5-6115-357-12	Generator Set, Deisel Engine, Wheel Mounted, Liquid Cooled, 15 KW, 400 Hertz, AC, 3 Phase, 4 Wire, 120/208 V; Nonwinterized, Special Purpose (Model SP-HF-15) W/Engine Hercules Model D198ERX28.
TB 703-1	Specification List of Standard Liquid Fuels, Lubricants, Preservatives, and Related Products Authorized for Use by the US Army

3. Painting

AR 740-1	Storage and Supply Activity Operations
AR 746-5	Color, Marking, and preparation of Army Equipment for Shipment.

4. Maintenance

FM 29-2	Organizational Maintenance Management
SB 700-50	Expendable Items (Except: Medical, Class V, Repair Parts, and Heraldic Items).
TB 750-236	Calibration Requirements for the Maintenance of Army Materiel.
TB 750-651	Use of Anti Freeze Solutions and Cleaning Compounds in Engine Cooling Systems.
TM 5-764	Electric Motor and Generator Repair
TM 9-2610-200-20	Organizational Care, Maintenance, and Repair of gpneumatic Tires and Inner Tubes.
TM 9-6140-200-15	Operator, Organizational, Direct Support, and General Support Maintenance Manual: Storage Batteries: Lead-Acid Type.
TM 38-750	The Army Maintenance Management System (TAMMS)

TM 5-6115-357-20P	Organizational Maintenance Repair Parts and Special Tool Lists: Generator Set, Diesel Engine: Wheel Mounted Liquid Cooled, 15 KW, 400 Hertz, AC, 3 Phase, 4 Wire, 120/208 V; Nonwinterized, Special Purpose Model SP-HF-15, FSN 6115-089-5099.
TM 5-6115-357-35P	Direct Support, General Support, and Depot Maintenance Repair Parts and Special Tools Lists: Generator Set, Diesel Engine: Wheel Mounted, Liquid Cooled, 15 KW, 400 Hertz, AC, 3 Phase, 4 Wire, 120/208 V; Nonwinterized, Special Purpose Model SP-HF-15. FSN 6115-089-5099.
TM 11-483	Radio Interference Suppression

5. Shipment and Storage

TB 740-97-2	Preservation of USAMECOM Mechanical Equipment for Shipment and Storage.
TM 740-90-1	Administrative Storage of Equipment

6. Demolition

TM 750-244-3	Procedures for Destruction of Equipment to Prevent Enemy Use (Mobility Equipment Command).

7. Operation

TM 5-766	Electric Power Generation in the Field

Page 121. Appendix C is superseded as follows:

APPENDIX C
BASIC ISSUE ITEMS LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED

Section I. INTRODUCTION

C-1. Scope

This appendix lists items required by the operator for operation of the generator set.

C-2. General

This list is divided into the following sections:

a. Basic Issue Item List—Section II. Not applicable.

b. Items Troop Installed or Authorized List—Section III. A list of items in alphabetical sequence which, at the discretion of the unit commander, may accompany the generator set. These items are not subject to turn-in with the generator set when it is evacuated.

C-3. Explanation of Columns

The following provides an explanation of the columns in the tabular list of items troop installed or authorized, section III.

a. Source, Maintenance and Recoverability Code (SMR). Not applicable.

b. Federal Stock Number. This column indicates the Federal stock number assigned to the item which will be used for requisitioning purposes.

c. Description. This column indicates the Federal item name and any additional description of the item required.

d. Unit of Measure (U/M). A two character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based; e.g., ft, ea, pr; etc.

e. Quantity Authorized. This column indicates the quantity of the item authorized to be used with the equipment.

Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

(1) SMR Code	(2) Federal stock number	(3) Description	(4) Unit of meas	(5) Qty auth
	7520-559-9618	CASE: maintenance and operation manuals	ea	1
	5975-878-3791	ROD ASSEMBLY: ground	ea	1

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Official:
VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25D (qty rqr block No. 1042) Organizational Maintenance Requirements for Generator Sets: 15 KW 400 HZ Precise Power.

Changes in force: C 1, C 2, and C 3

TM 5-6115-357-15
C 3

CHANGE
NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *16 December 1974*

Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual
GENERATOR SET, DIESEL ENGINE; WHEEL MOUNTED, LIQUID COOLED, 15 KW, 400 HERTZ, AC, 3 PHASE, 4 WIRE, 120/208V; NON-WINTERIZED, SPECIAL PURPOSE (MODEL SP-HF-15)
FSN 6115-089-5099

TM 5-6115-357-15, 28 December 1967, is changed as follows:

Page 2 of Cover. Warnings are added as follows:

BEFORE OPERATION:

WARNING

Do not rely on grounding or safety devices to prevent accidents. Electrical circuits and equipment are potentially hazardous. Personnel should always exercise caution to prevent injury or possible death due to electrical shock.

DURING OPERATION:

WARNING

Operation of this equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

AFTER OPERATION:

WARNING

Drycleaning solvent, Fed spec P-D-680, used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. The flash point of solvent is 100° F. (38° C.) - 138° F. (59° C.).

Page 3. In paragraph 1, subparagraph *c* is superseded as follows:

c. You can improve this manual by recommending improvements using DA Form 2028 (Recommended Changes to Publications and Blank Forms) and mailing the form to Commander, US Army Troop Support Command, ATTN: AMSTS-MPP, 4300 Goodfellow Boulevard, St. Louis, MO 63120. A reply will be furnished direct to you.

Page 21. In paragraph 7, subparagraph *b* is superseded as follows:

b. Grounding Procedure.

CAUTION

Generator sets should be grounded in order to prevent shock due to defective insulation or external electrical faults. Poor grounding can endanger personnel, may damage equipment, and can create interference in communication or electronic circuits.

(1) Install one of the following items as a grounding device:

(a) Drive a ground rod to a depth of at least 8 feet. This is the preferred device which is available in the Army supply system.

(b) Drive a ground pipe, ¾-inch, copper or steel, to a depth of at least 8 feet. An existing underground pipe may be used in an emergency.

(c) Bury a ¼-inch thick iron or steel plate, approximately 18-inch x 18-inch size, with ground cable attached, to a depth of at least 4 feet.

(d) Bury a 1/16-inch thick aluminum or copper plate approximately 18-inch x 18-inch size, with ground cable attached, to a depth of at least 4 feet.

(2) Saturate the area around the grounding device with water to increase conductivity.

(3) Connect the ground cable from the grounding device to the generator set frame ground post (fig. 1) and tighten the nut securely.

NOTE

Ground cables should be copper. Braided cable is the best, but No. 6 AWG gage (or larger) copper wire will suffice.

Page III, Paragraph 1 is superseded as follows:

Fire Protection and Safety

TB 5-4200-200-10	Hand Portable Fire Extinguishers Approved for Army Users.
TB MED 251	Noise and Conservation of Hearing

By Order of the Secretary of the Army:

FRED C. WEYAND
General, United States Army
Chief of Staff

Official:
VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25D, (qty rqr block No. 1042) Organizational Maintenance Requirements for Generator Sets: 15 KW, HZ, Precise Power.

Changes in force: C 1, C 2, C 3, and C 4

TM 5-6115-357-15
C 4

CHANGE
NO. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *4 May 1979*

Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual
GENERATOR SET, DIESEL ENGINE; WHEEL MOUNTED, LIQUID COOLED, 15 KW, 400 HERTZ, AC, 3 PHASE, 4 WIRE, 120/208V; NON-WINTERIZED, SPECIAL PURPOSE
(MODEL SP-HF-15)
NSN 6115-00-089-5099

TM 5-6115-357-15, 28 December 1967, is changed as follows:

Page 20. Paragraphs e and f are superseded as follows:

e. Operating Supplies.

Fuel Tank Capacity	14 gallons
Fuel	Diesel, regulator grade DF2
Fuel Consumption (approximately at full load)	Full tank for 8 hours
Lubrication Oil Capacity	6 quarts
Cooling System Capacity	15 quarts

f. Wheel Mount.

Manufacturer	Hol-Gar Manufacturing Corp.
Length	126 3/4 in. (overall)
Width	72 1/2 inches (overtires at bottom)
Tire Size	9.00/16
Tire Pressure	35 psi

Page 29. Paragraph 17d is modified as follows:

d. Engine Stops Suddenly.

Probable cause	Possible remedy
Fuel supply depleted.	Replenish fuel supply.
Dirty or defective electric fuel pump.	Clean or replace fuel pump.
Fuel systems clogged.	Clean fuel system.
Engine overspeeds.	Replace fuel injection pump. Overspeed switch tripped; reset before restarting.
High coolant temperature.	Refer to c. below, "Engine Overheats".
Low oil pressure.	Refer to f. below, "Low Oil Pressure".
Air cleaner clogged.	Clean air cleaner.
Defective fuel injection pumps	Replace defective fuel injection pumps.
Leaking or broken fuel line.	Tighten or replace fuel lines.
Piston seizure.	Overhaul engine.
Bearing seizure.	Overhaul engine.

Page 30. Paragraph 17j is modified as follows:

j. Engine Overspeeds.

Probable cause	Possible remedy
Defective fuel injection pump governor.	Replace fuel injection pump.
Defective overspeed switch	Replace overspeed governor.

Page 37. Additional instructions, including figure 22A are added to paragraph 19d.

d. Fuel Oil Filter and Water Separator (figs. 21, 22 and 22A). Because of the extremely accurate construction of various parts of the fuel injection system, the engine is equipped with two fuel filters and a water separator unit to remove dirt particles and water from the system. These units are equipped with removable elements which must be inspected and replaced at regular intervals. During repair/depot maintenance remove the water separator with bracket and discard by using the following instructions and block diagram (fig. 22A).

(1) Disconnect input and output lines at water separator and electric plug, P42.

(2) Remove four mounting bolts on water separator mounting bracket and retain.

(3) Discard water separator, mounting bracket and water separator drain hose.

(4) Reinstall four mounting bolts removed in step (2).

(5) Remove and discard fuel line between secondary electric fuel pump and primary fuel filter.

(6) Remove primary fuel filter from mounting bracket, rotate filter 180° horizontally and reinstall using original hardware.

(7) Remove fuel line from output of primary fuel filter and reinstall between input side of filter and output side of secondary electric fuel pump.

(8) Route and connect loose end of line from day tank (previously disconnected from output of water separator) to the output side of primary fuel filter.

NOTE

In rerouting fuel lines be sure lines are placed in such a manner to avoid chafing.

(9) Cut cable one inch from P42 and discard.

(10) Strip end of wires P18A16 and P13J16.

NOTE

To verify that proper wires have been stripped, check for continuity between wire end P18A16 and P39 pin A and P13J16 and TB1-19. Two out of three wires from P39 should have continuity to TB1-19.

(11) After verification of proper wires, connect together using solderless connectors.

(12) Turn wire ends into harness and secure firmly with tape.

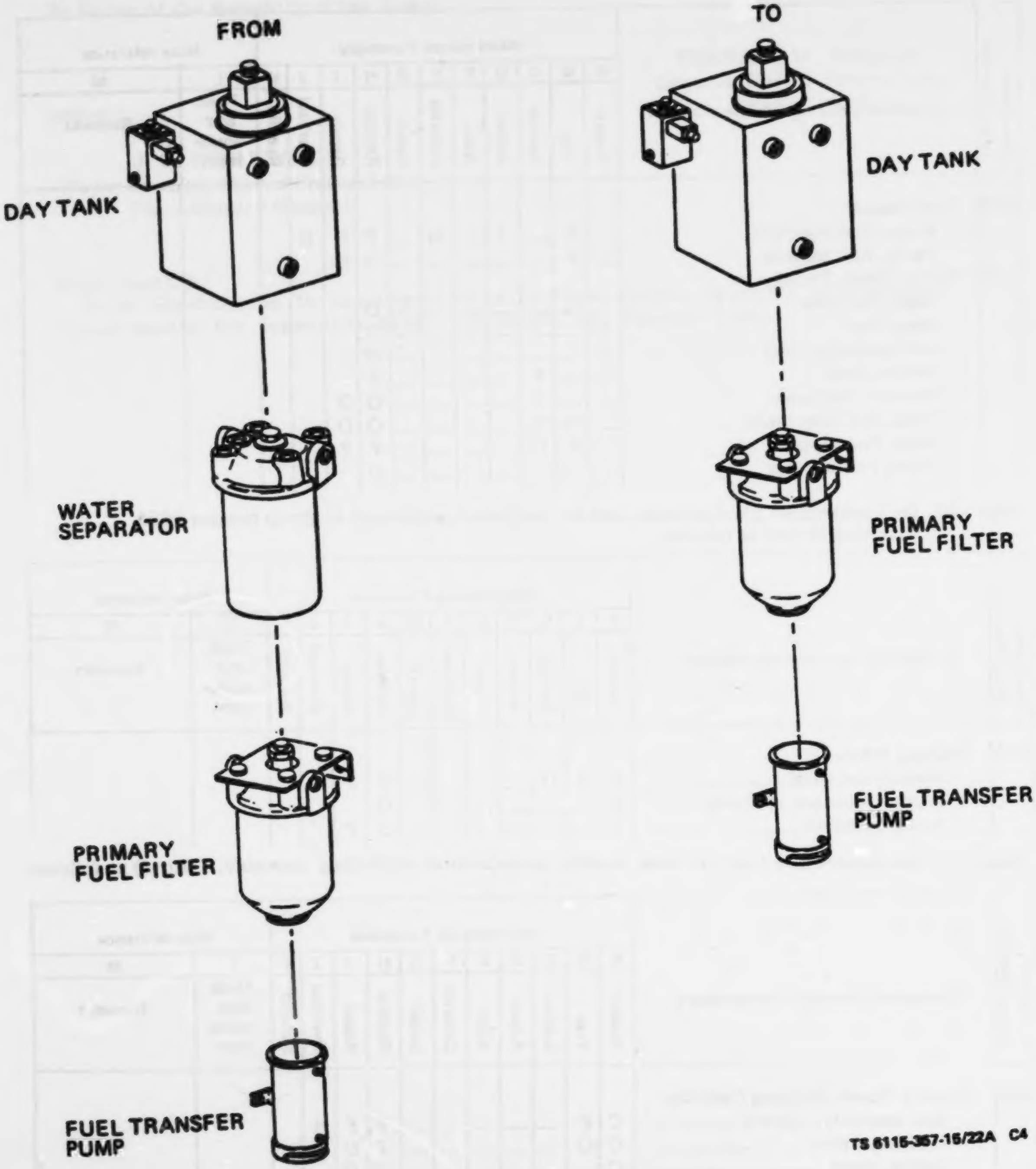
(13) Remove P20 from solenoid L20.

(14) Remove L20 and discard.

(15) Cut wires 1 inch from P20. Discard P20 and terminate wires.

NOTE

L20 removed in step (14) is interchangeable with L30 and can be retained as a replacement (day tank solenoid).


FROM
TO
DAY TANK
DAY TANK
WATER SEPARATOR
PRIMARY FUEL FILTER
PRIMARY FUEL FILTER
FUEL TRANSFER PUMP
FUEL TRANSFER PUMP

TS 6115-357-15/22A C4

Figure 22A. Fuel System, Modification Block Diagram

Page 115. On maintenance function table, group numbers 0302 (fuel pumps) and 0306 (nozzle, fuel) are modified as follows:

Functional Group Number	Component assembly nomenclature	Maintenance Functions											Note reference	
		A	B	C	D	E	F	G	H	I	J	K	L	M
		Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
0302	Fuel Pumps:													
	Pump, fuel injection	....	F	....	F	....	H	....	F	H	H			
	Pump, fuel transfer	....	F	....	....	....	....	....	O	O				
0306	Tanks, Lines, Fittings:													
	Gage, fuel tank	C	O	....	....	....	....	....	O					
	Hose, fuel	O	....	....	....	....	....	....	O					
	Line assembly, fuel	....	....	....	....	....	....	....	O					
	Nozzle, fuel	....	....	F	....	....	....	....	F					
	Strainer, fuel tank	....	....	C	....	....	....	....	O	O				
	Tank, fuel (day tank)	....	O	C	....	....	....	....	O	O				
	Tank, fuel supply	....	F	C	....	....	....	....	F	F				
	Valve, fuel selector	....	....	....	....	....	....	....	O					

Page 116. On maintenance function table, add an additional component to group number 0603 (Starting Motor) as follows:

Functional Group Number	Component assembly nomenclature	Maintenance Functions											Note reference	
		A	B	C	D	E	F	G	H	I	J	K	L	M
		Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
0603	Starting Motor:													
	Starter, electrical	O	O	O	....	....	....	....	O	F				
	Brushes, contact, solenoid.........	O	....	....	....	....	....	....	O					
	Relay, solenoid	O	....	....	....	....	....	....	O	F				

Page 119. On maintenance function table, modify group number 4009 (Box Assembly, Control) as follows:

Functional Group Number	Component assembly nomenclature	Maintenance Functions											Note reference	
		A	B	C	D	E	F	G	H	I	J	K	L	M
		Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
4009	Control Panels, Housing Cubicles:													
	Box assembly, control	C	F	....	....	....	....	....	F	F	H			
	Harness, wiring........................	C	O	....	....	....	....	....	F	O				
	Lights, panel	C	....	....	....	....	....	....	O	O				
	Meters, electrical	C	....	....	....	....	....	....	O					

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-25D, Operator maintenance requirements for Generator Sets: 15 KW 400 HZ, Precise Power.

TM 5-6115-357-15

No. 5-6115-357-15
TECHNICAL MANUAL

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *28 December 1967*

Operator, Organizational, Direct and General Support, and Depot Maintenance Manual

GENERATOR SET, DIESEL ENGINE: WHEEL MOUNTED, LIQUID COOLED, 15 KW, 400 HERTZ, AC, 3 PHASE, 4 WIRE, 120/208 V; NON-WINTERIZED, SPECIAL PURPOSE (MODEL SP-HF-15) FSN 6115-089-5099

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SECTION I
INTRODUCTION

1. General

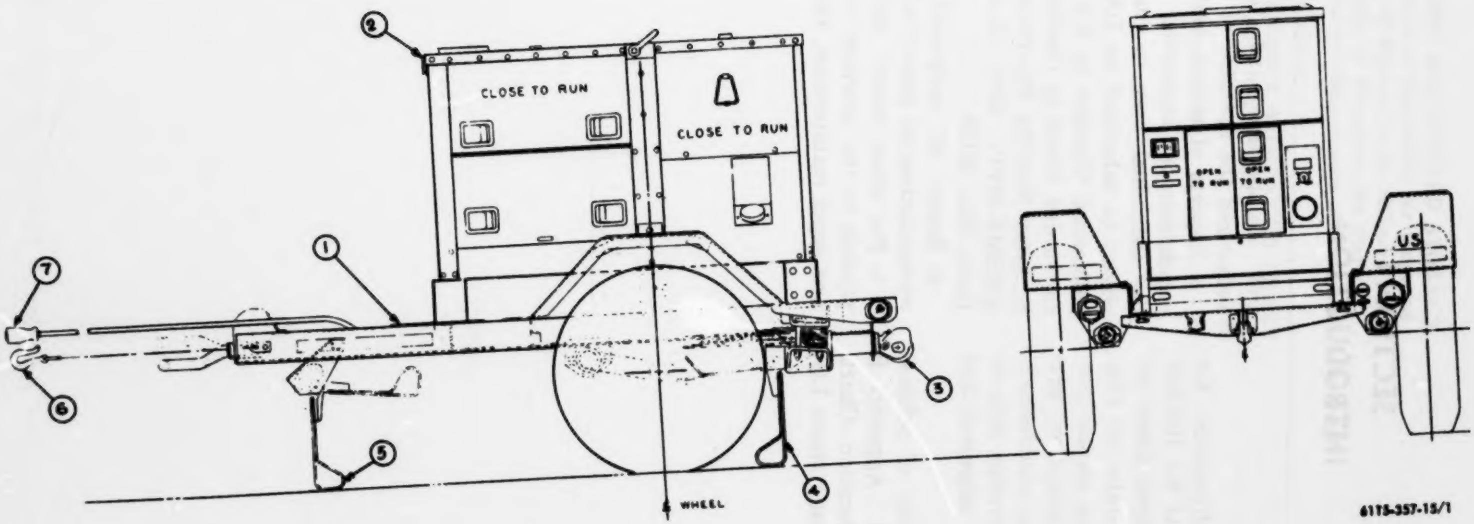
a. This manual contains information for the operation and maintenance of the Hol-Gar Model SP-HF-15, 15 KW, 400 Hertz diesel engine driven, wheel mounted generator set (fig. 1). Sections 1 through VI of the manual provide data on the installation, operation, preventive maintenance and services, troubleshooting and repair. Section VII provides data on demolition; Section VIII, on shipment and limited storage.

b. Appendix A contains a list of publications applicable to this manual. Appendix B contains the Maintenance Allocation Chart. Appendix C gives the Basic Issue Items List and Maintenance and Operating Supplies authorized the operator of this equipment.

c. Reports of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding General, U. S. Army Mobility Equipment Command, Attn: AMSME-MPP, 4300 Goodfellow Blvd., St. Louis, Mo., 63120.

d. Report all equipment improvement recommendations as prescribed by TM 38-750.

e. For other record and report forms applicable to the operator, organizational, field, and depot maintenance, refer to TM 38-750.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CLOSE TO RUN
CLOSE TO RUN
OPEN TO RUN
OPEN TO RUN
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WHEEL

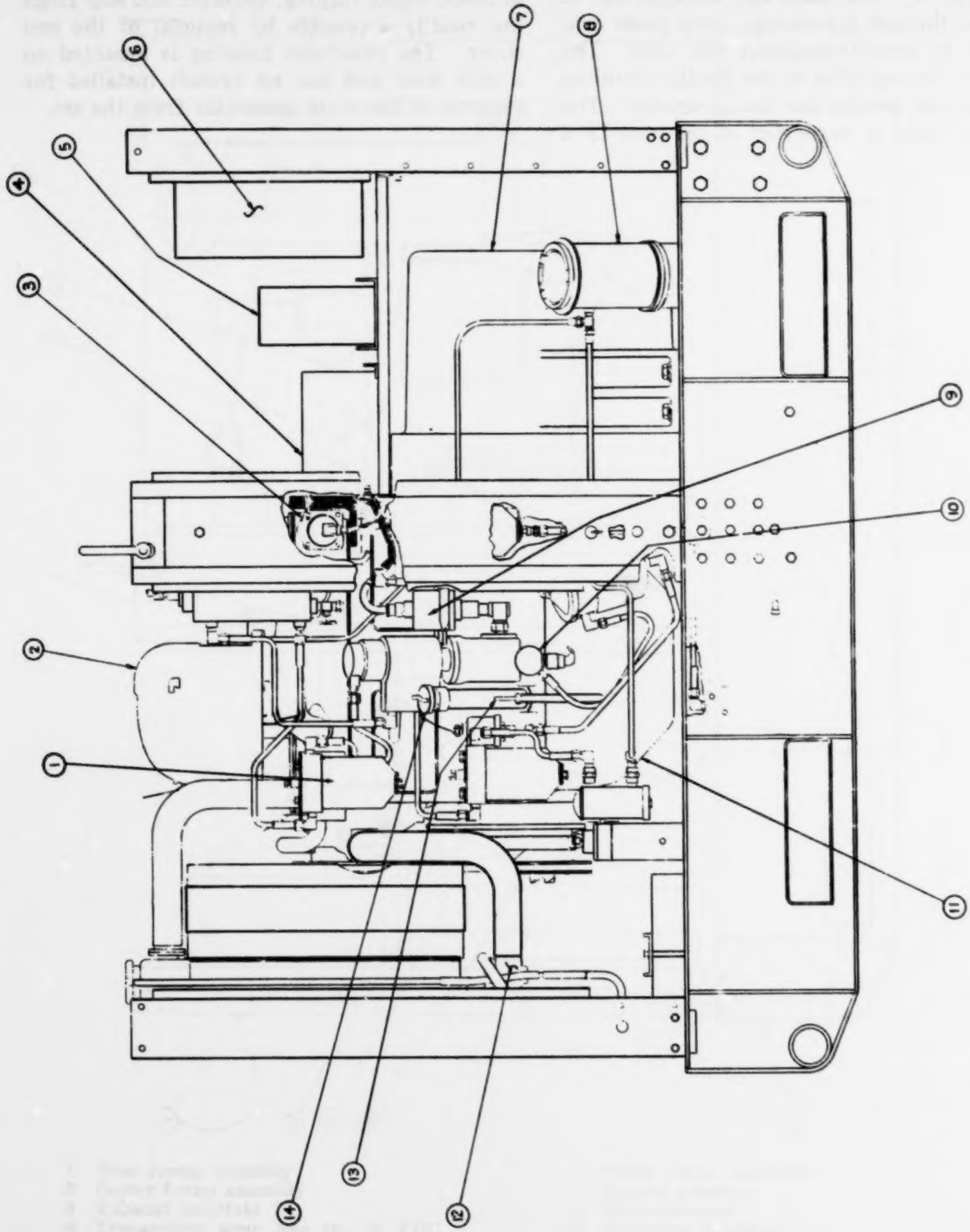
6175-357-15/1

1 Trailer assembly
2 Generator set assembly
3 Rear pintle hook assembly
4 Rear landing leg
5 Front landing leg
6 Safety hook
7 Wiring harness

Figure 1. Hol-Gar model SP-HF-15 motor generator set, wheel-mounted.

2. Description

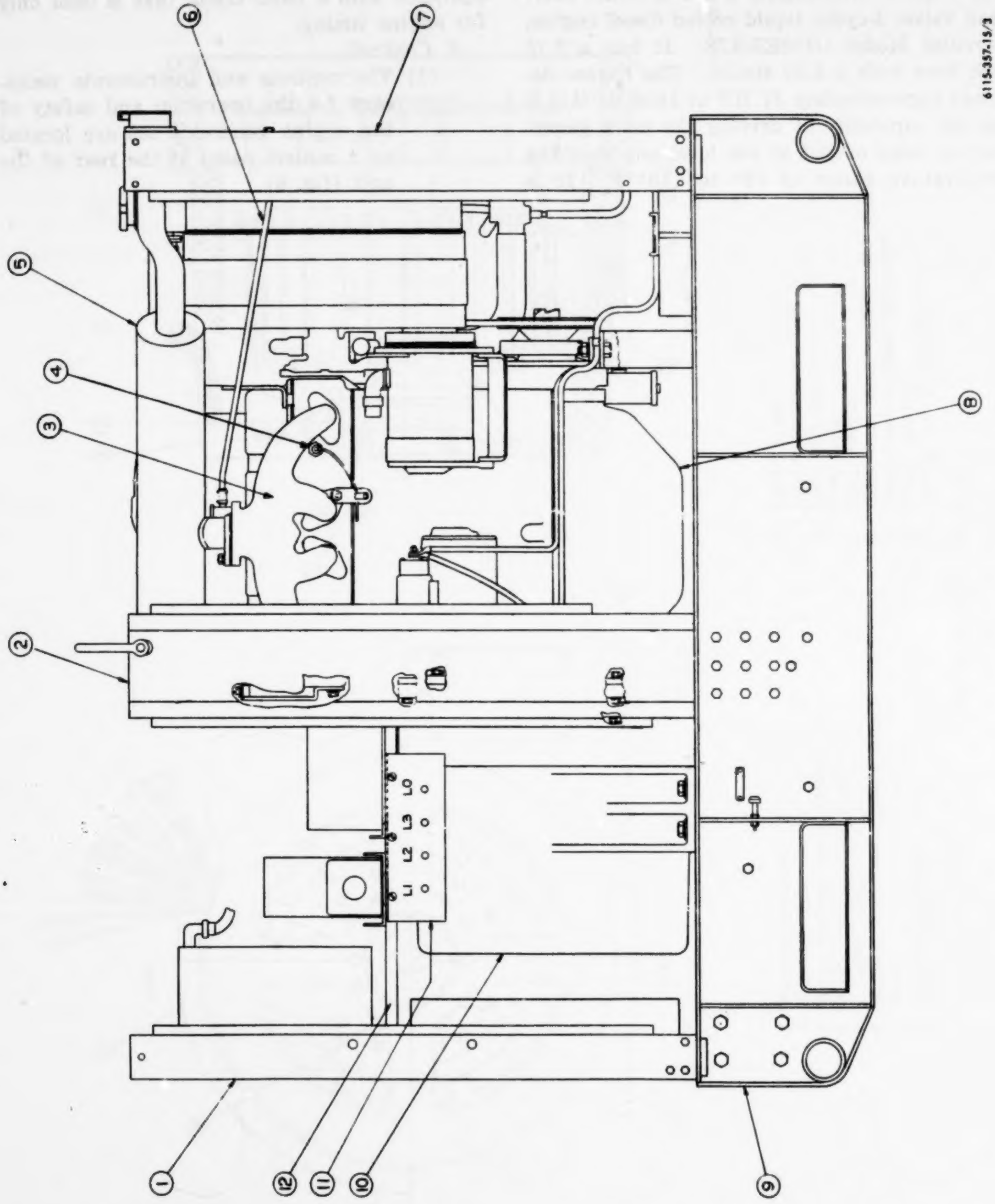
a. Generator Set. The generator set (figs. 2 and 3) is a self-contained weather-resistant, electric power unit which provides 120/208 volt, 400 Hertz, 3 phase, 4 wire output. The generator set consists of the following major components: Main Generator, Engine, Controls, Fuel System, Battery Charging Circuit, Coolant System. Housing, and Wheel Mount.



1 Fuel filter
2 Air cleaner assembly
3 Temperature switch
4 Voltage regulator
5 Exciter
6 Control box
7 Generator assembly
8 Fuel tank filler assembly
9 Overspeed switch
10 Pressure switch
11 Engine assembly
12 Shutter thermostat
13 Dip stick
14 Oil receptacle

Figure 2. Hol-Gar model SP-HF-15 generator set, subassembly, left side view.

b. Main Generator (figs. 4 and 5). The main generator is a single bearing, rotating field, 1846 RPM, sychronous type, utilizing a static exciter with a transformer-coupled voltage regulator. The leads are brought out of the frame through a bushing. Drip proof construction is used throughout the unit. The generator fan, mounted to the flexible coupling disk, provides cooling for the generator. The generator rotor is supported at one end by a ball bearing. The other end of the rotor is provided with a flexible disk which is bolted directly to the engine flywheel. The rotor is electrically and mechanically balanced. The brushes, brush rigging, collector and slip rings are readily accessible by removal of the end cover. The generator housing is mounted on a skid base and has an eyebolt installed for removal of the main generator from the set.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L1
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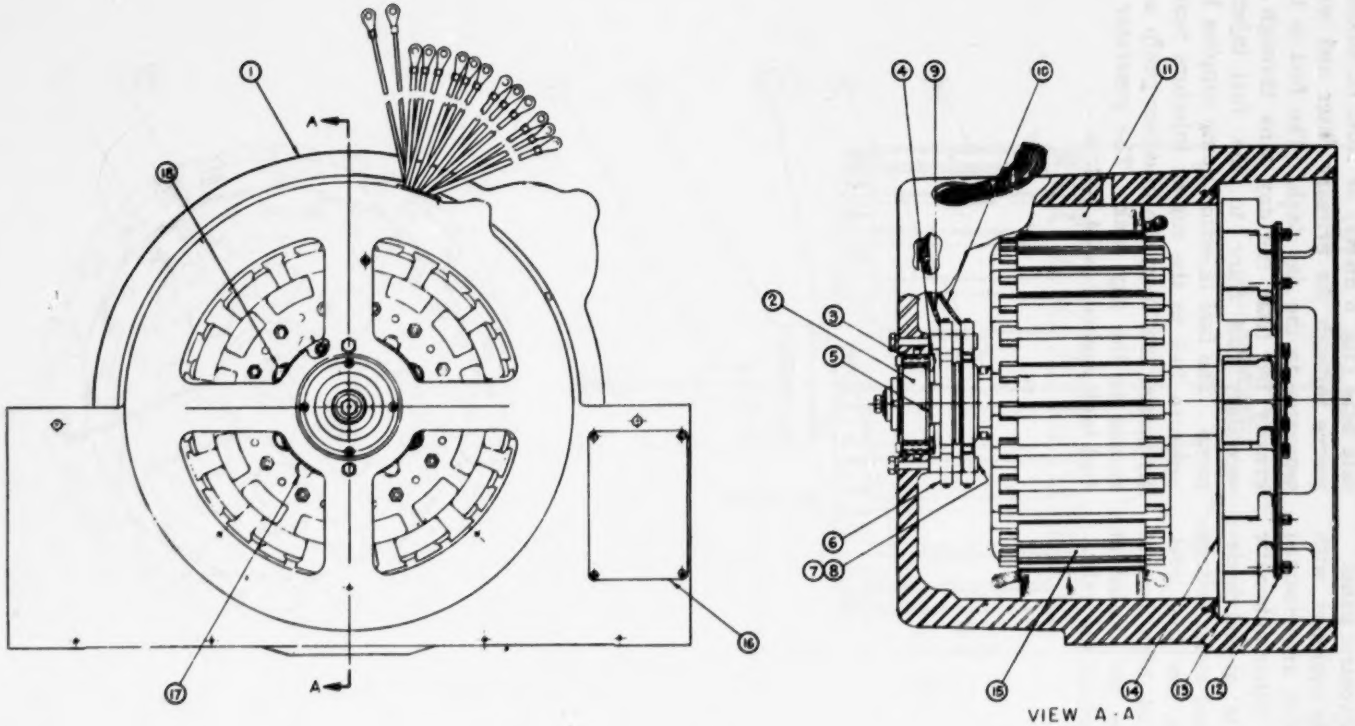
1	**Rear frame assembly**	7	**Front frame assembly**
2	**Center frame assembly**	8	**Engine assembly**
3	**Exhaust manifold**	9	**Skid assembly**
4	**Transmitter temp elec res 24 VDC**	10	**Generator assembly**
5	**Exhaust assembly**	11	**Load panel**
6	**Crankcase vent assembly**	12	**Component tray assembly**

Figure 3. Hol-Gar model SP-HF-15, generator set, subassembly, right side view.

c. Engine. The engine is a 4-cylinder, overhead valve, 4-cycle, liquid cooled diesel engine, Hercules Model D198ERX28. It has a 3.75 inch bore with a 4.50 stroke. The engine develops approximately 37 HP at 1846 RPM. It has the capability of driving the main generator at rated output at sea level and over the temperature range of 32° to 110° F. It is equipped with a hand crank that is used only for engine timing.

d. Controls.

(1) The controls and instruments necessary for the operation and safety of the engine generator set are located on a control panel at the rear of the unit (fig. 6).



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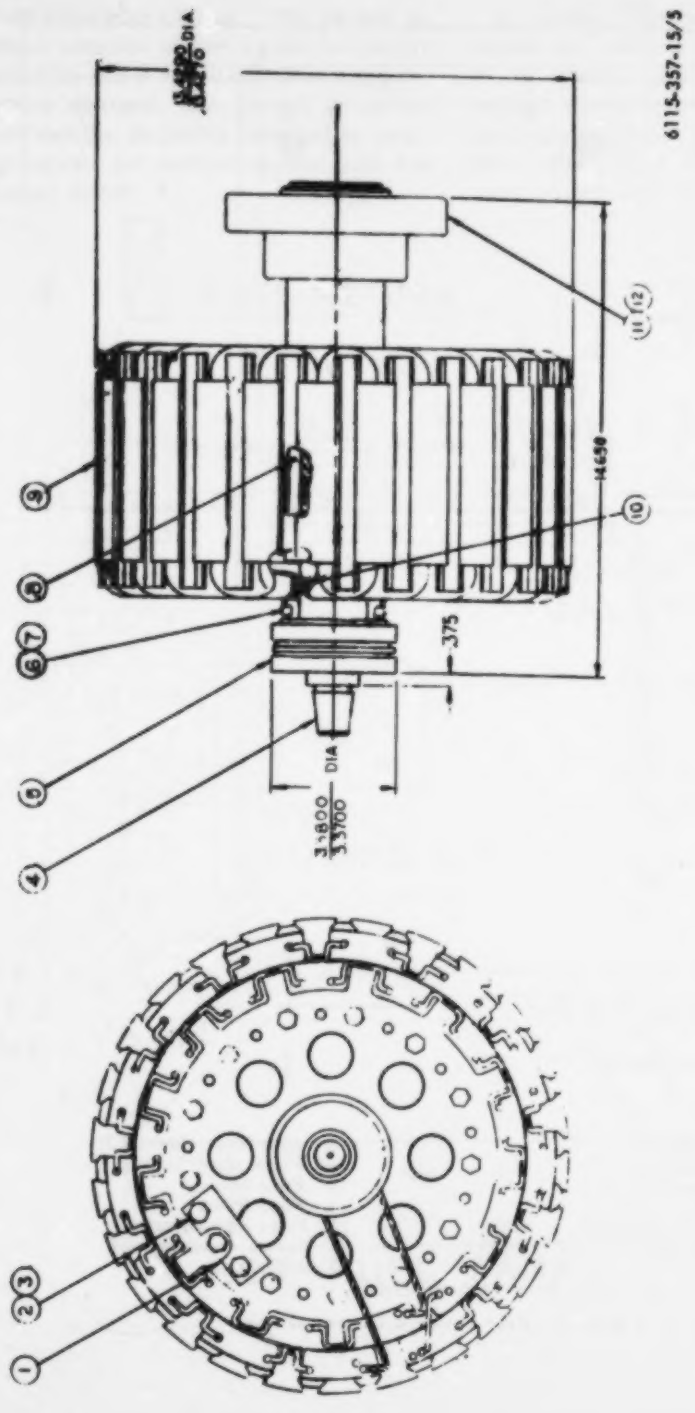
1	Housing generator
2	Bearing, ball
3	Ring, bearing, stop, outside
4	Ring, bearing, stop, inside
5	Adapter, shaft
6	Holder, electrical contact brush
7	Post
8	Spacer, insulation
9	Cable, brush
10	Cable, brush
11	Generator stator 15KW
12	Disc, coupling
13	Fan, rotor
14	Ring, baffle
15	Generator rotor, 15KW, 400 cycles
16	Identification plate, generator
17	Brush, carbon
18	Spring, spiral, torsion

Figure 4. Main Generator.

(2) Outlets for both the 120/208 ac power output and the 120-volt, single phase, 400 Hertz, 15 ampere output are located below the control panel.

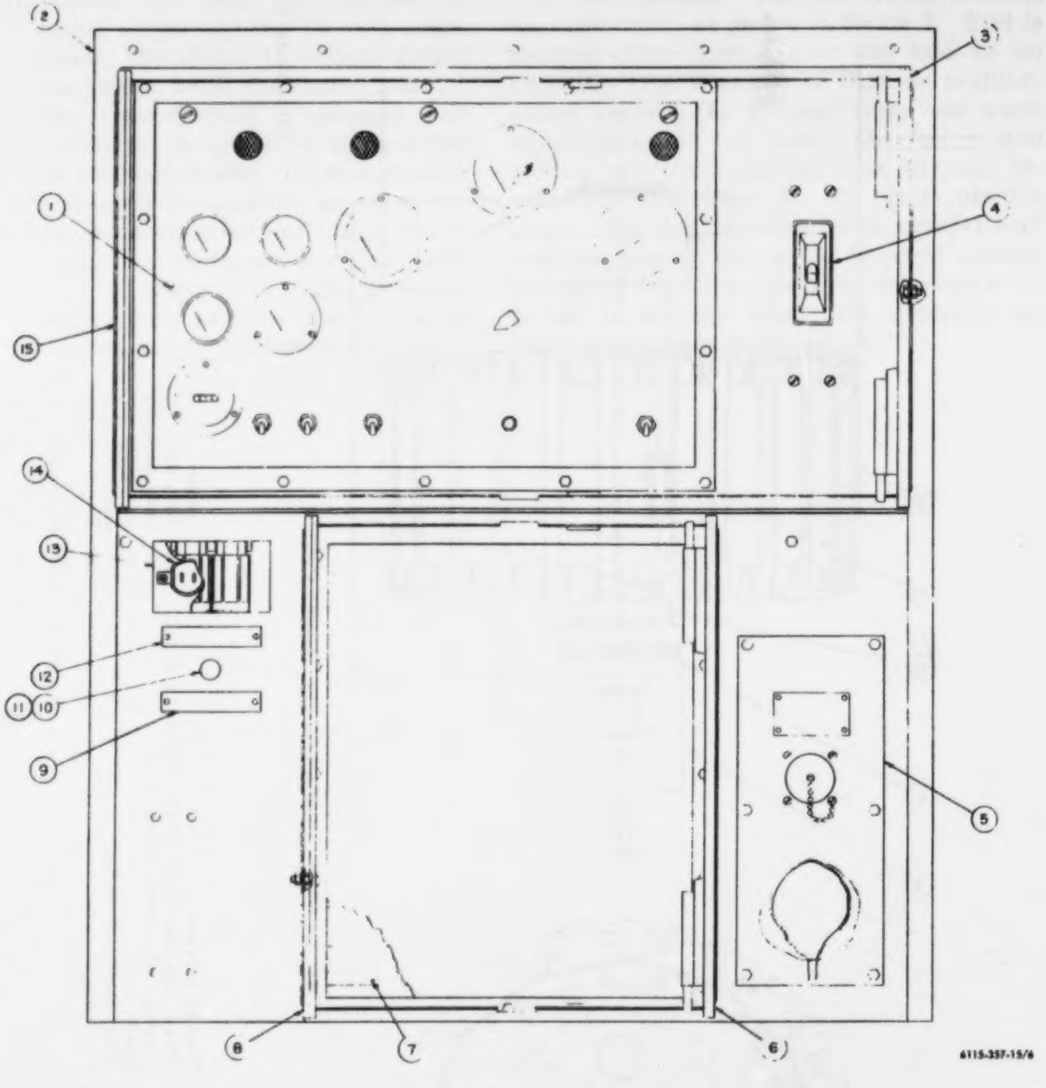
(3) The control panel is equipped with watertight doors which are mounted on the unit frame. Other automatic and safety components; ac and dc circuit breakers, over and under voltage trips, and overspeed, low fuel level, low oil pressure and high coolant temperature switches are located at various points throughout the unit.

e. Fuel Systems. The fuel system contains the components as shown in figure 7. Fuel is pumped either from the set fuel tank in the skid base (fig. 8 and 9) or from an auxiliary source through the primary filter and water separator to the day tank. The fuel is then gravity fed from the day tank through the secondary fuel filter to the fuel injection pump. The fuel injection pump supplies high pressure fuel to the engine injectors nozzles. By-passed fuel from the injection pump is returned to the day tank. The generator set fuel tank capacity is 14 gallons.



1	Weight balance	7	Solder
2	Screw, cap, hex hd. 5/16-18 UNC-2A x 3/4 L	8	Key, rotor
3	Washer, lock, split, helical 5/16	9	Core assembly
4	Shaft, rotor	10	Reisiglass banding tape
5	Ring, electrical contact	11	Hub
6	Connector	12	Key

Figure 5. Rotor assembly.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6115-357-15/6

1 Control box assembly
2 Rear frame weldment
3 Rear door, upper-RH
4 Circuit breaker
5 Receptacle panel assembly
6 Rear door, lower-RH
7 Louvre-rear
8 Rear door, lower-LH
9 Plate identification
10 Fuse holder
11 Fuse F03A
12 Plate, identification
13 Cover, weatherproof
14 Receptacle
15 Rear door, upper-LH

Figure 6. Rear frame with control box.

f. Battery Charging Circuit. The 24-volt dc power circuit consists of two series connected 12-volt batteries and a regulated 18-ampere rotating battery charger. The 24-volt dc power circuit provides the dc power required to operate the generator set control system and the engine starter motor.

g. Cooling System. The engine is a liquid-cooled unit with a radiator having a capacity of 15 quarts. The coolant is circulated by a coolant pump located at the forward end of the engine block. The coolant enters the pump from the lower section opening. It is then pumped through coolant distribution passages

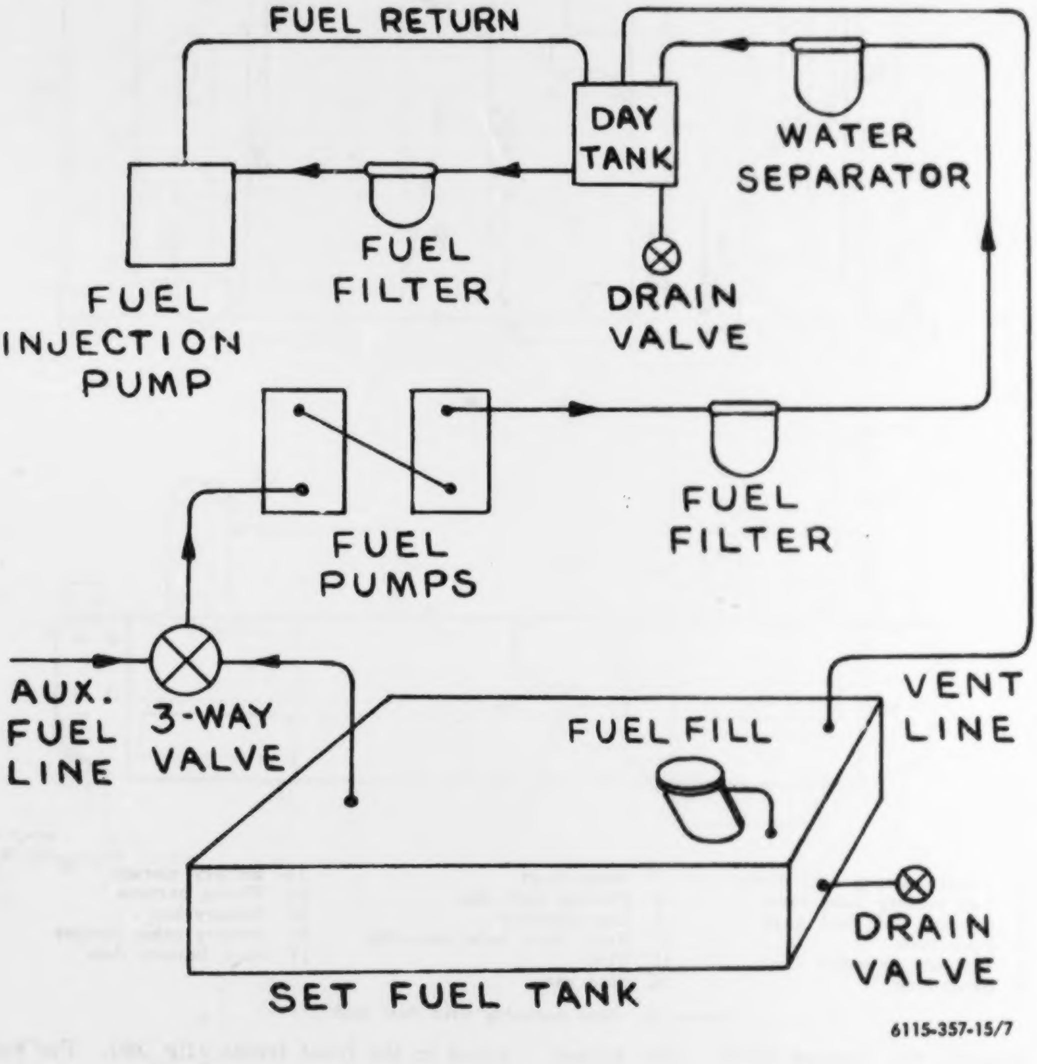
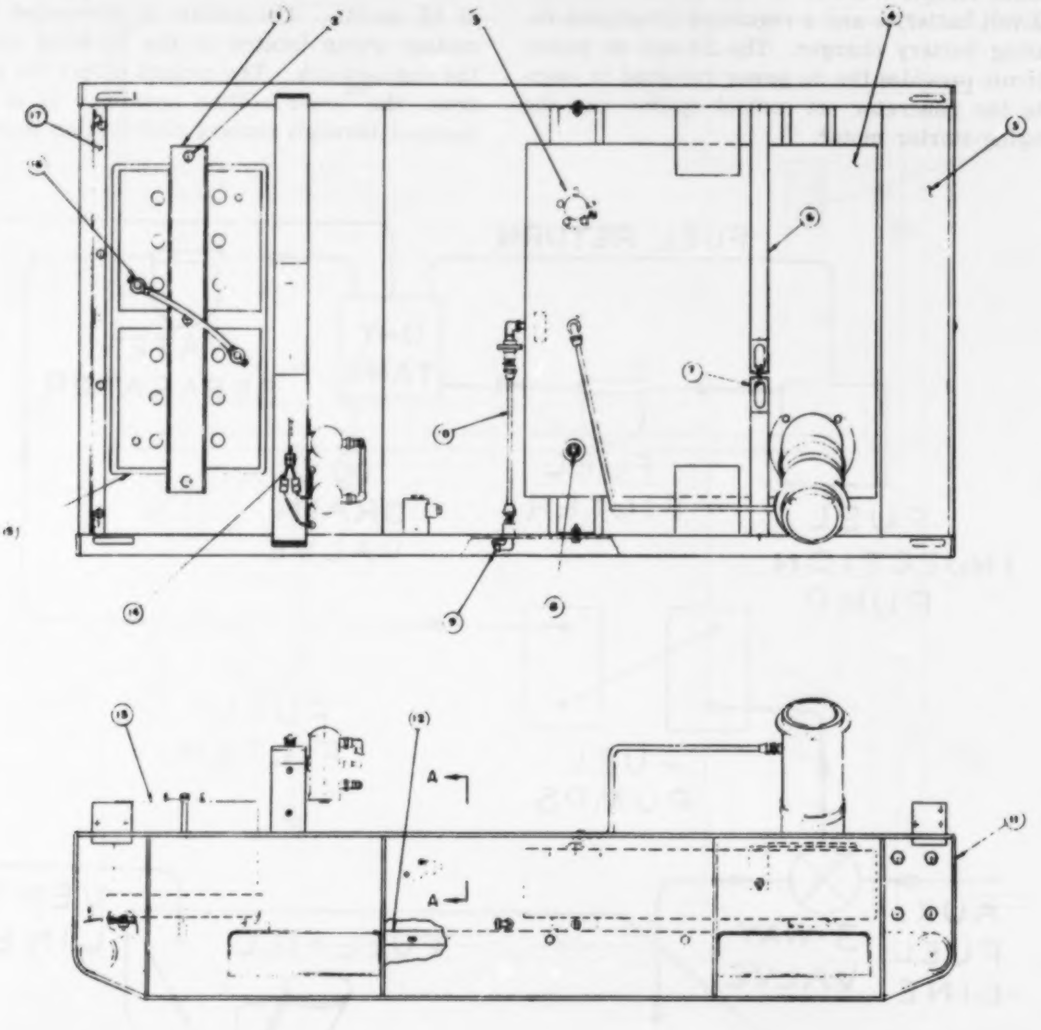

FUEL RETURN
DAY TANK
WATER SEPARATOR
FUEL FILTER
DRAIN VALVE
FUEL INJECTION PUMP
FUEL PUMPS
FUEL FILTER
AUX. FUEL LINE
3-WAY VALVE
VENT LINE
FUEL FILL
DRAIN VALVE
SET FUEL TANK
6115-357-15/7

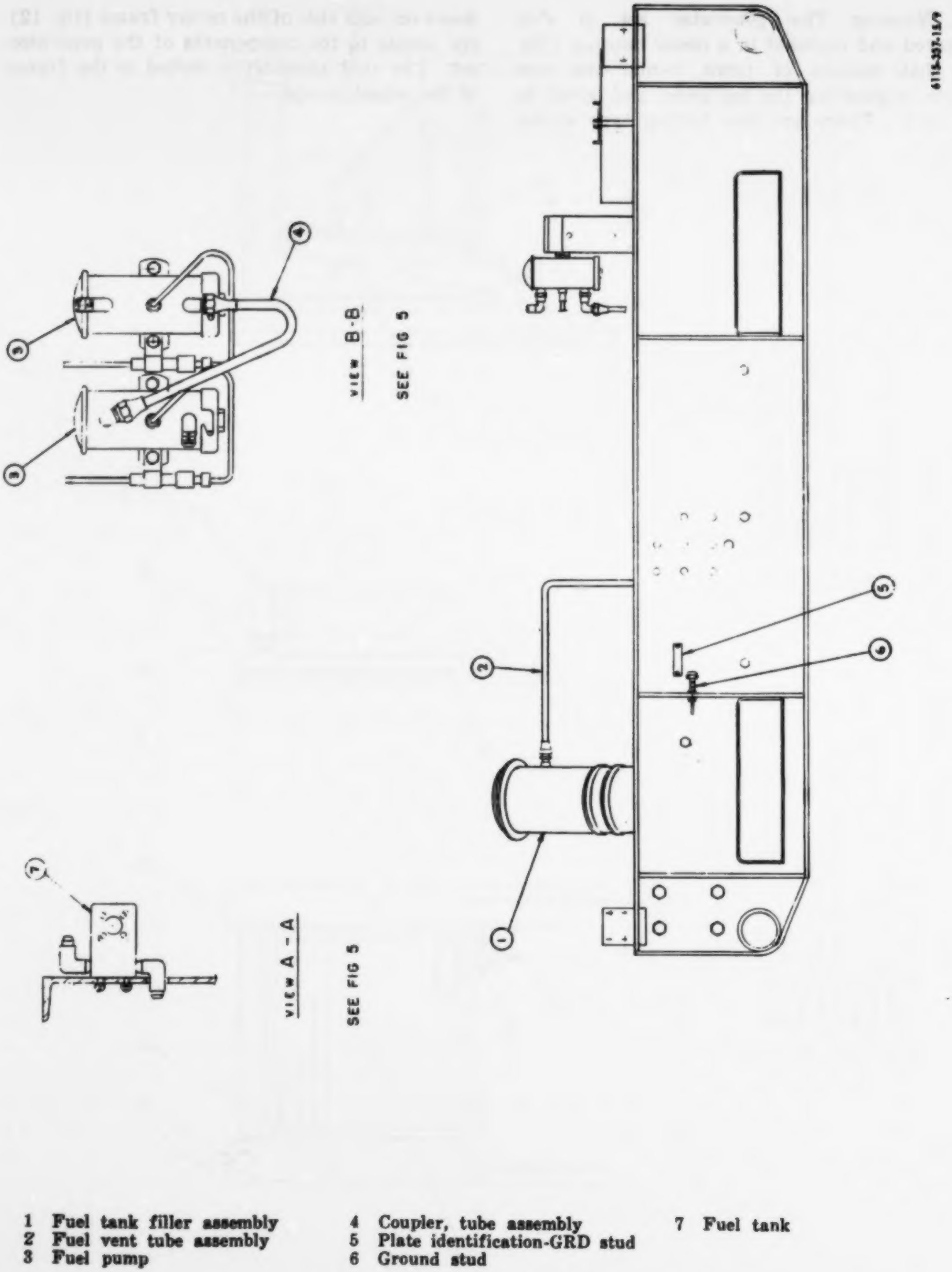
Figure 7. Fuel system schematic.



1 Clamp battery hold down
2 Bolt battery hold down
3 Sending unit fuel gage
4 Fuel tank
5 Tool box assembly
6 Strap-long
7 Strap-short
8 Pick-up fuel line
9 Cap assembly
10 Fuel drain tube assembly
11 Skid
12 Skid pan
13 Battery storage
14 Wiring harness
15 Battery box
16 Battery cable jumper
17 Stop, battery door

Figure 8. Skid assembly with fuel tank.

and through the engine block. The heated coolant leaves the cylinder head through the thermostat housing. The thermostat controls the opening of the bypass which allows the coolant to be recirculated in the engine block or passed to the radiator. The radiator is secured to the front frame (fig. 10). For cooling the generator set, the engine fan pulls ambient air in the intake louvers (fig. 6) through the set enclosure and exhausts the air through the radiator and thermostatically controlled shutters.



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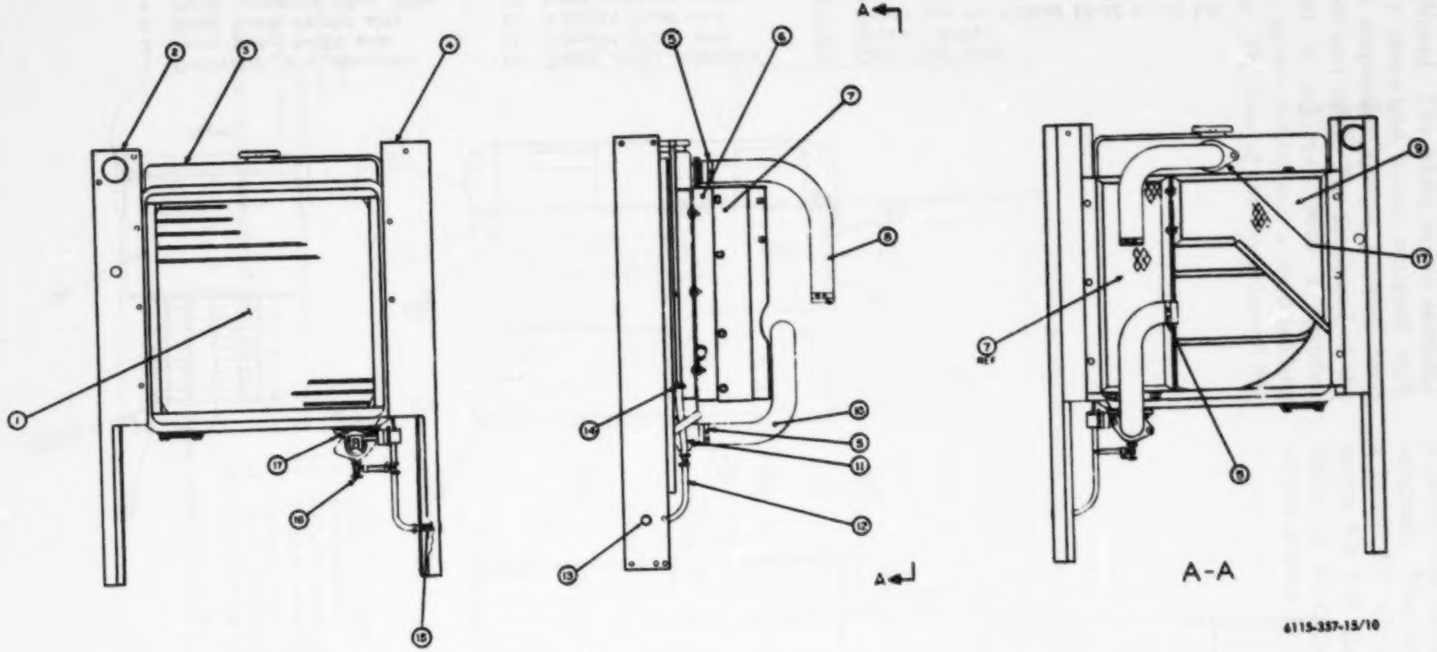
VIEW B-B
SEE FIG 5
VIEW A-A
SEE FIG 5

1 Fuel tank filler assembly	**4 Coupler, tube assembly**	**7 Fuel tank**
2 Fuel vent tube assembly	**5 Plate identification-GRD stud**	
3 Fuel pump	**6 Ground stud**	

Figure 9. Skid assembly with fuel pump.

h. Housing. The generator set is skid mounted and enclosed in a metal housing (fig. 11) that consists of front, center and rear frames supporting the top panel and bolted to the skid. There are two folding type access doors on each side of the center frame (fig. 12) for access to the components of the generator set. The skid assembly is bolted to the frame of the wheel mount.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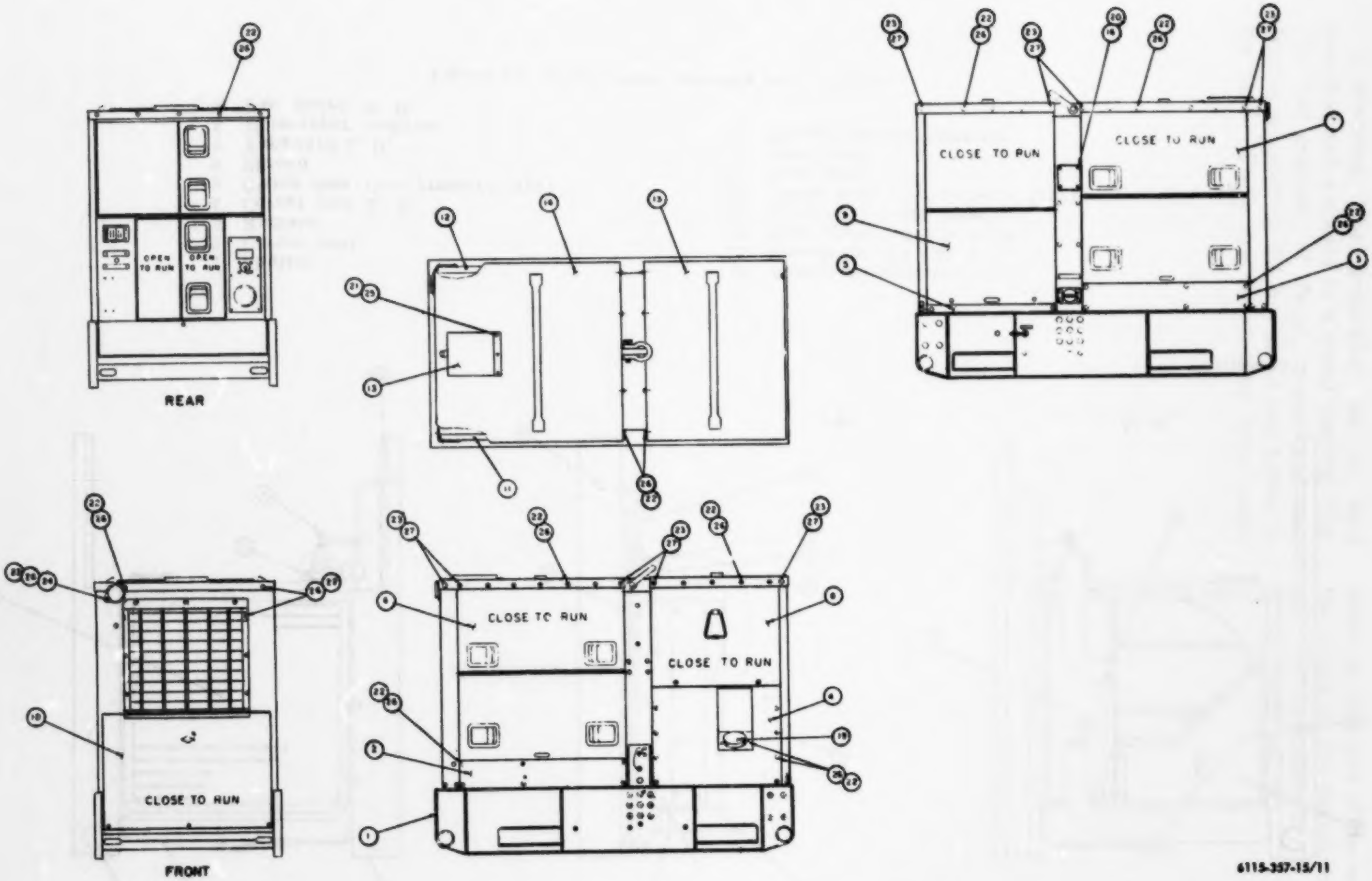
6115-357-15/10

1	Shutter
2	Corner post
3	Radiator
4	Corner post L. H.
5	Clamp hose (low pressure type)
6	Shroud
7	Fanguard L. H.
8	Hose-upper radiator
9	Fan guard R. H.
10	Hose-lower radiator
11	Hose-drain 3/8 I.D. x 7
12	Hose drain 3/8 I.D. x 18
13	Coupling 1/4 std. steel
14	Clamp hose (low pressure type)
15	Hose stem
16	Drain cock
17	Flange-radiator assembly

Figure 10. Front frame assembly with radiator.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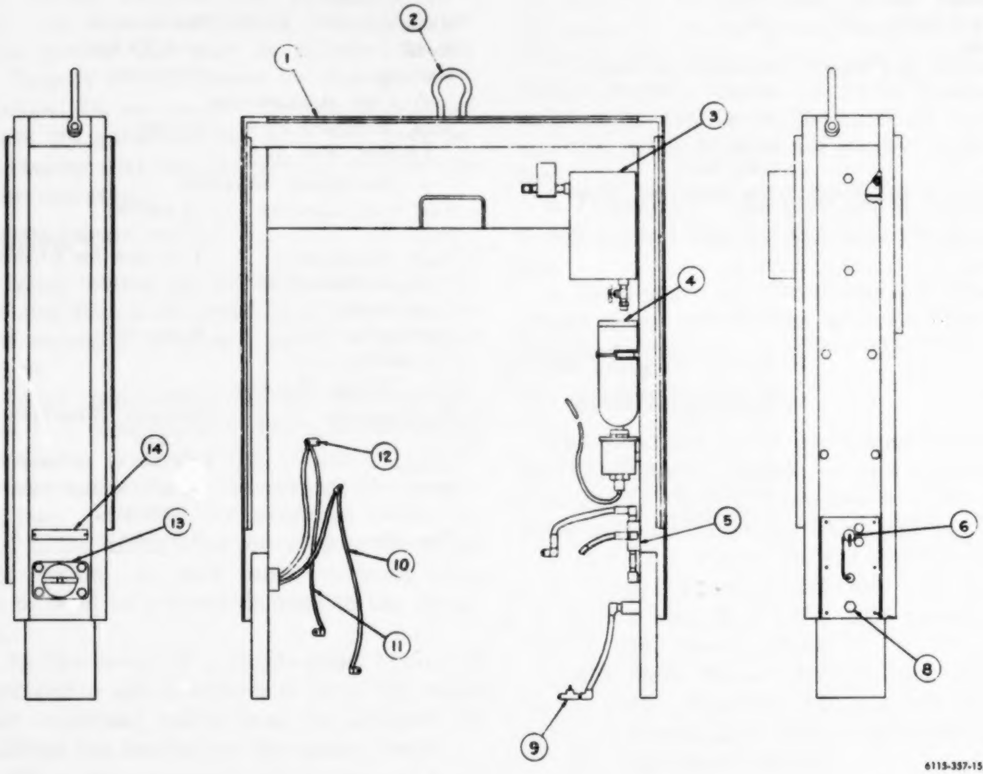
6115-357-15/11

1	Generator sub assembly
2	Door panel—left side
3	Door panel—right side
4	Panel assembly—fuel filler
5	Panel generator access
6	Door engine access L.H.
7	Door engine access assembly
8	Component access door
9	Door generator access
10	Front grille assembly
11	Support front roof
12	Support front roof
13	Door radiator access
14	Roof—front
15	Roof—rear
16	Plate—identification
17	Not used
18	Not used
19	Cap—fuel tank
20	Screw—drive
21	Screw hex hd. slotted 10-32 x 1/2 LG
22	Screw cap 1/4 20 x 3/4 LG
23	Screw cap 3/8 16 x 3/4 LG
24	Washer—flat 1/4
25	Washer—Split No. 10
26	Washer—split 1/4
27	Washer—split 3/8

Figure 11. Generator set housing.

i. Wheel Mount. The wheel mount assembly (fig. 1) is a two-wheel mount equipped with an axle and suspension system, parking hand brake, wheels and tires. The front end of the wheel mount is equipped with a drawbar coupler, two safety chains, and a front landing leg assembly. The rear of the wheel mount has a pintle hook assembly and a rear landing leg assembly. The wheel mount is installed with a 24-volt DC wiring system which receives its power for the wheel mount stop and blackout lights by plugging into the power receptacle of the towing vehicle.



1	Center frame
2	Clevis, lifting
3	Day tank assembly
4	Starting aid ether
5	Cock, 3-way
6	Cap, tube and chain assembly 37 degrees only
7	Not used
8	Plug, 1/2 NPT
9	Cock, shutoff
10	Battery cable assembly, positive
11	Battery cable assembly, negative
12	Ground strip
13	Slave receptacle assembly
14	Identification plate, slave receptacle

Figure 12. Center frame assembly.

3. Tabulated Data

a. Generator Set.

Manufacturer	**Hol-Gar Mfg. Corp.**
Model	**SP-HF-15**
Stock No.	**6115-089-5999**
Duty	**Continuous**
Mounting	**Skid Base. Wheel Mounted**
Rating	
KVA	**21.6**
Voltage	**120/208, 4 wire**
Power factor	**0.94**
Phase	**3**
Dimensions and Weight (Generator Set Only)	
Length	**65 in.**
Width	**34 in.**
Height	**52 in.**
Weight	**2,300 lbs.**
Dimensions and Weight (Generator Set Wheel Mounted)	
Length	**127 in.**
Width	**74 in.**
Height	**73 in.**
Weight	**3,200 lbs.**

b. Main Generator.

Manufacturer	**Electric Machinery Mfg. Co.**
Model	**Military Standard**
Part No.	**13205E4607**
Rating (within set)	
KVA	**21.6**
Voltage	**120/208, 4 wire**
Power Factor	**0.94 lagging**
Phase	**3**
Rating (generator only)	
KVA	**18.50**
Voltage	**120/208, 4 wire** **240/416, 4 wire** **120, 3 wire** **120, 2 wire** **120/240, 3 wire**
Power Factor	**0.80 lagging**
Phase	**1 and 3**
Frequency	**400 Hertz**

c. Engine.

Manufacturer	**Hercules**
Model	**D198ERX28**
Starting	**Electrical**

d. Unit Accessories.

Hose, Auxiliary Fuel	**25 feet**
Adapter, Fuel Tank	

e. Operating Supplies.

Fuel Tank Capacity	**14 gallons**
Fuel	**Diesel, regular grade DF2**
Fuel Consumption (approximately at full load)	**Full tank for 8 hours**
Lubrication Oil Capacity	**6 quarts.**

f. Wheel Mount.

Manufacturer	**Hol-Gar Manufacturing Corp.**
Length	**126 3/4 in. (overall)**
Width	**72 1/2 inches (overtires at bottom)**
Tire Size	**9.00/16**

SECTION II
INSTALLATION

4. Unpacking

Unpack the generator set as close to the installation site as possible. When unpacking the equipment, remove all securing straps, wires, blocks, padding and protective tape. Follow any special unpacking instructions or caution notices that may be attached to the unit. Inspect the equipment for damage.

Caution: **Do not operate controls or attempt to start the generator set until you have become familar with the controls and serviced the set for operation.**

5. Moving

a. When towing the generator set it is recommended that it be towed by a motor vehicle not to exceed a maximum speed of 20 miles per hour.

b. When transporting the unit for long distances, it is recommended that it be carried by a rail flatcar or lowboy flat trailer.

c. When hoisting is necessary, the equipment may be lifted by overhead cables attached to the lifting eyes provided on the wheel mount frame. In such cases, spreader bars must be used to prevent damage to the equipment.

d. In the event of a single-point lifting of the generator set to remove it from the wheel mount, overhead cables may be attached to the lifting eye located on the center frame.

e. When the generator set is removed from the wheel mount it may be lifted by a fork lift with the prongs set into the openings provided in the skid base.

6. Site Considerations

Consider the following when selecting and preparing an installation site for the engine generator set.

a. Proximity of Load. To reduce transmission line voltage losses, place the engine generator set as close as possible to the load.

b. Clearances. Maintain a minimum of four feet around the engine generator set to provide sufficient ventilation for proper operation of the set.

c. Fuel Supply. The generator set fuel tank contains an 8-hour fuel supply. An auxiliary fuel supply may be connected to the generator set to provide a longer period of operation. The bottom of the tank of the auxiliary supply must not be more than 12 feet below the generator set. Under all conditions before operating the set, drain the fuel tank of water and foreign matter. Drain fuel by using valve located on the fuel tank. The auxiliary fuel hose and fuel drum adapter are located in the tool box.

d. Foundation. Check ground to insure that it will support the unit and have proper drainage.

e. Leveling. Check level visually. The unit should never be operated at more than a 15° deviation from the horizontal plane.

7. Electrical Connections

The generator set is permanently connected for 120/208-volt, 3-phase, 4-wire output.

a. Power Output Connections. There are three output connections which can be utilized:

(1) *Main Power Output Receptacle (fig. 6)*. Provides 120/208 volt, 3-phase, 4-wire, 21.8 KVA, 0.94 power factor, 400 Hertz output.

(2) *Main Power Output Terminals (fig. 3)*. Provides 120/208-volt, 3-phase, 4-wire, 21.8 KVA, 0.94 power factor, 400 Hertz output.

(3) *Convenience Receptacle (fig. 6)*. Provides 120-volt, single phase, 2-wire, 15-amp, 400 Hertz output.

b. Ground Connection. Install a Number 6 AWG bare copper wire from the ground terminal on the generator set skid base to the ground rod. Make sure all connections are tight.

Warning: **Do not operate the generator set until the ground terminal has been connected to a suitable ground. Electrical faults in the generator set, load lines, or load equipment can cause death by electrocution when contact is made with an ungrounded system.**

Note. The ground wire and ground rod are not supplied with the generator set.

8. Mechanical Connections

a. Fuel Line. The generator set is supplied with one auxiliary fuel hose and a fuel drum adapter for use when an external fuel source is required. The hose is connected to the set at the auxiliary fuel inlet fitting. The fuel drum adapter is screwed into the fuel drum opening to make a fuel hose connection to the external supply.

b. Exhaust. If the generator set is used inside a shelter connect a suitable exhaust tube to the set exhaust opening and exit it outside of the shelter.

c. Air Ducts. If the unit is used in a shelter and it is practicable, construct an air duct from the engine to remove the heated engine air from the shelter.

9. Delivery Services

After the engine generator set is inspected for completeness and adjusted to specific operational requirements at the factory, the fuel, lubrication oil, and coolant are drained from the respective systems. Before operation of the engine generator set, perform the following services:

a. Visual. Check the engine generator set equipment for completeness, damage or loose parts. Correct any defiencies.

b. Lubrication. Using the engine dipstick, check the level of the lubrication oil. There may be an indication of oil because of drainage from the engine filters, and oil lines. Drain this residual oil and discard it. Fill the crankcase to the full mark on the dipstick. The capacity is 6 quarts of oil conforming to MIL-L-2104 grade, OE-30. Check for and correct any leaks.

c. Fuel. Fill internal fuel tank with clean diesel fuel.

d. Air Cleaner. See that openings are clear. Check that fittings are tight.

e. Controls. Check all controls to see that they are in normal off position.

f. Electrical Connections. Check that all electrical connections are correct and tight.

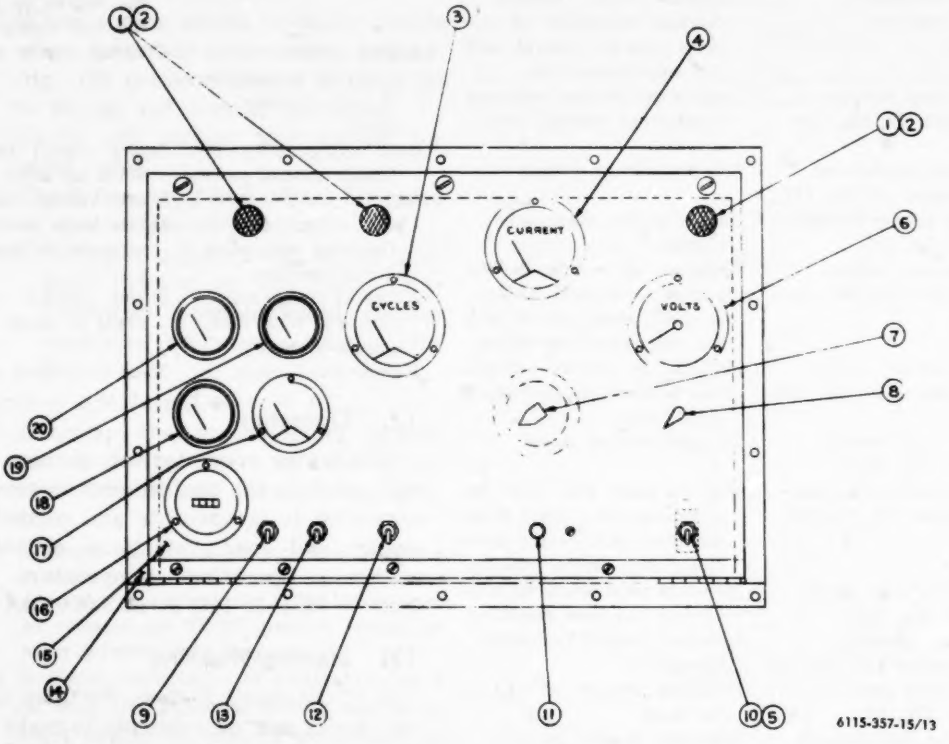
g. Mechanical Connections. Check that all mechanical connections are tight.

h. Operational Check (Sec. III). Fill radiator to capacity and make operational check.

SECTION III
OPERATION INSTRUCTIONS

10. General

This section describes, locates and furnishes the operator with information about the controls and instruments for the proper operation of the generator set. All operating controls and indicating instruments are on the control panel (fig. 13). The control panel is at the rear of the housing and is protected by two hinged doors. The panel is divided into two sections; the left side for engine controls, the right for the generator controls.



1	**Lamp, incandescent double contact**
2	**Light panel**
3	**Frequency meter 400 hertz**
4	**A.C. ammeter**
5	**Cover switch**
6	**AC Voltmeter**
7	**Volt Amp selector switch**
8	**Voltage adjustment rheostat**
9	**Ether primer switch**
10	**Protection bypass switch**
11	**DC Circuit breaker**
12	**Panel light switch**
13	**Start-run-stop switch**
14	**Control box**
15	**Control box panel**
16	**Running time meter**
17	**Battery charging ammeter**
18	**Fuel gage**
19	**Temperature gage**
20	**Oil Pressure gage**

Figure* 13. *Control Box Assembly.

11. Controls, Instruments and Components

The controls, instruments and components (figs. 2,6,9,12,13) utilized in the operation and safety of the engine generator set are listed with their functions below.

Item	*Function*
Panel lights (2, fig. 13).	Provides light for control panel.
Frequency meter (3, fig. 13).	Indicates output frequency.
AC Ammeter (4, fig. 13).	Indicates percent-rated load current.
AC Voltmeter (6, fig. 13).	Indicates output voltage. Normal indication is 120 volts line-to neutral and 208 volts line-to line.
Volt-Amp selector switch (7, fig. 13).	Used in conjunction with and monitoring voltage and current.
Voltage adjustment rheostat (8, fig. 13).	Adjusts voltage output.
Ether primer switch (9, fig. 13).	Use to inject ether into engine.
Protection bypass switch (10, fig. 13).	Bypasses all safety devices except overspeed switch and AC short circuit trip for emergency operation.
DC Control circuit breaker (11, fig. 13).	Protects dc control circuit and provides an emergency shut down.
Panel light switch (12, fig. 13).	To light control panel.
Engine-start-run-stop switch (13, fig. 13).	Use to start and stop the generator set. Start is up position; run, center position; stop, down position.
Running time meter (16, fig. 13).	Monitors total length of time the set has been operating.
Battery charging ammeter (17, fig. 13).	Monitors battery generator charge.
Fuel level gage (18, fig. 13).	Indicates amount of fuel in set tank.
Coolant temperature gage (19, fig. 13).	Indicates engine temperature.
Oil pressure gage (20, fig. 13)	Indicates lube oil pressure.
High coolant temperature switch (3, fig. 2).	Shuts engine down when engine overheats.
Voltage regulator (4, fig. 2).	Maintains constant output of voltage with changes in load.
Overspeed switch (9, fig. 2).	Automatically stops engine in event of overspeed. Also cuts out engine starter and actuates field flash relay (K5).
Low oil pressure switch (10, fig. 2).	To stop engine in case of low oil pressure.
Lube oil dip gage (13, fig. 2).	Indicates level of lube oil in crankcase. Has full and low marks.
Main circuit breaker (4, fig. 6).	Connects or disconnects load to generator.
Fuse (11, fig. 6).	Protects convenience receptacle output.
Convenience receptacle (Duplex) (14, fig. 6).	Supplies 120 volts, 15 amperes, single phase, 400 Hertz power.
Ground terminal stud (6, fig. 9).	Use to ground the generator set.
Three-way transfer valve (5, fig. 12).	Use to connect the external or internal fuel supply to the engine or to shut off the fuel supply completely.
Engine governor (internal component of full injection pump).	Controls engine speed.
Over voltage relay (inside control panel).	Opens circuit breaker, and shuts set down in event of over-voltage condition.
Under voltage trip (internal with main circuit breaker).	Opens main circuit in event of under voltage condition.
AC short circuit trip (internal with main circuit breaker).	Opens circuit breaker in event of short circuit.
Engine hand crank.	Used for timing of engine.

12. Operation

The engine generator set operates automatically, that is, the engine speed is governed and controlled to compensate and correct for frequency and load variations caused by load changes. Operating temperature range is from +.32°F to 110°F at 3,000 feet altitude.

13. Starting-Stopping

a. Preliminary Action. Perform the following checks and adjustments to make sure that the engine generator set is ready for use.

(1) Connect ground on set skid base to a well grounded rod.
(2) Check load cable connections.
(3) Place main circuit breaker to "OFF" position.
(4) Check lubricating oil level and add oil if necessary.
(5) Check coolant level and add coolant if necessary.
(6) Check fuel level.
(7) Check three-way transfer valve for proper handle position.

(8) Check batteries for proper electrolyte level and connections.

b. Starting.

(1) Place engine Start-Run-Stop switch S2 to START position.

Note. During the start-up of the generator set, the engine starter is automatically cut-out at 400 RPM by the overspeed switch and the generator field is automatically flashed by the overspeed switch and the field flash relay (K5). The engine starter cannot be energized when the engine is operating above 400 RPM.

(2) When engine starts, release switch when frequency meter starts indicating. Oil pressure should indicate 30 to 35 psi for normal operation.

(3) Check AC voltage and adjust for rated value.

(4) Check frequency and adjust for rated no load value—400 Hertz.

(a) To make adjustment, adjust governor linkage on the fuel pump. Clockwise increases speed, counter clockwise decreases, speed. (fig. 25)

c. Starting Aid Instructions + 32°F.

(1) Energize the engine ether primer switch (9, fig. 13) on left side of the control panel and then release. (fig. 14)

Note. Each time the switch is activated, a measured amount of ether is discharged from the primer cylinder. The switch must be released to "OFF" position before another injection may be made.

(2) A slave receptacle is available for a 24 volt DC external power source to start engine in case of generator set battery failure and also to charge generator set batteries.

Note. If engine is hard to start and requires prolonged use of starter, crank starter for 30 seconds, then allow a two minute cooling period.

(3) Proceed with *b.* above, starting instructions.

d. Load Application.

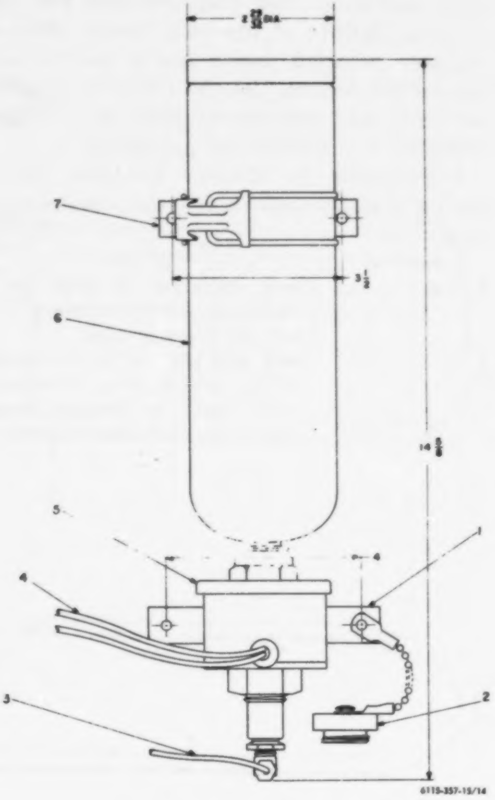
(1) Place load circuit breaker switch in "ON" position to provide power at the generator set load terminals.

(2) Check meters for proper readings. If overload exists, stop unit and adjust load.

e. Stopping.

(1) Remove load by pushing circuit breaker handle to "OFF" position.

(2) Push engine Start-Run-Stop switch to "OFF."



1 Bracket
2 Primer valve dust cap
3 Ether injection tube
4 Electrical connection
5 Primer valve
6 Ether cylinder
7 Mounting bracket

Figure 14. Ether Primer.

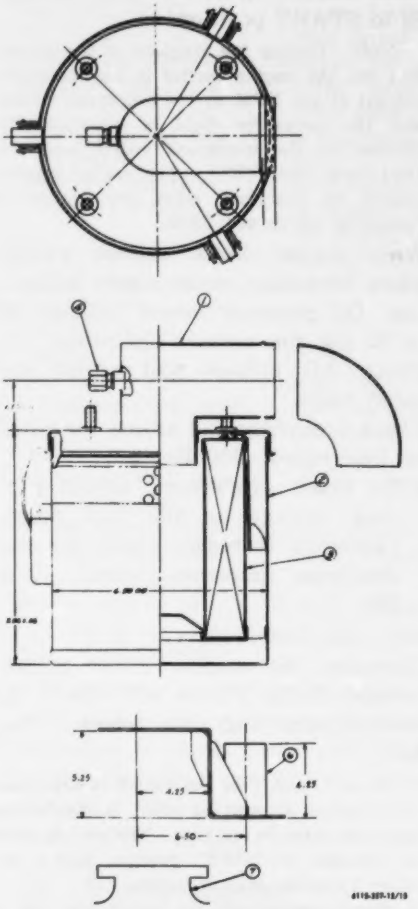
SECTION IV
MAINTENANCE

14. General

a. Procedure. Set up a maintenance procedure for the engine generator set based on the type of operation (i.e. continuous, standby or intermittent). The main items to remember are cleanness, lubrication, proper adjustment, leaks, loose parts and improper operation indicated by observation of instruments and control response. If inspections reveal erratic operation that may increase and cause complete failure of the unit, check, order and replace indicated faulty parts before actual breakdown occurs. Use the following minimum servicing and adjustment rules as a guide to establish a maintenance procedure.

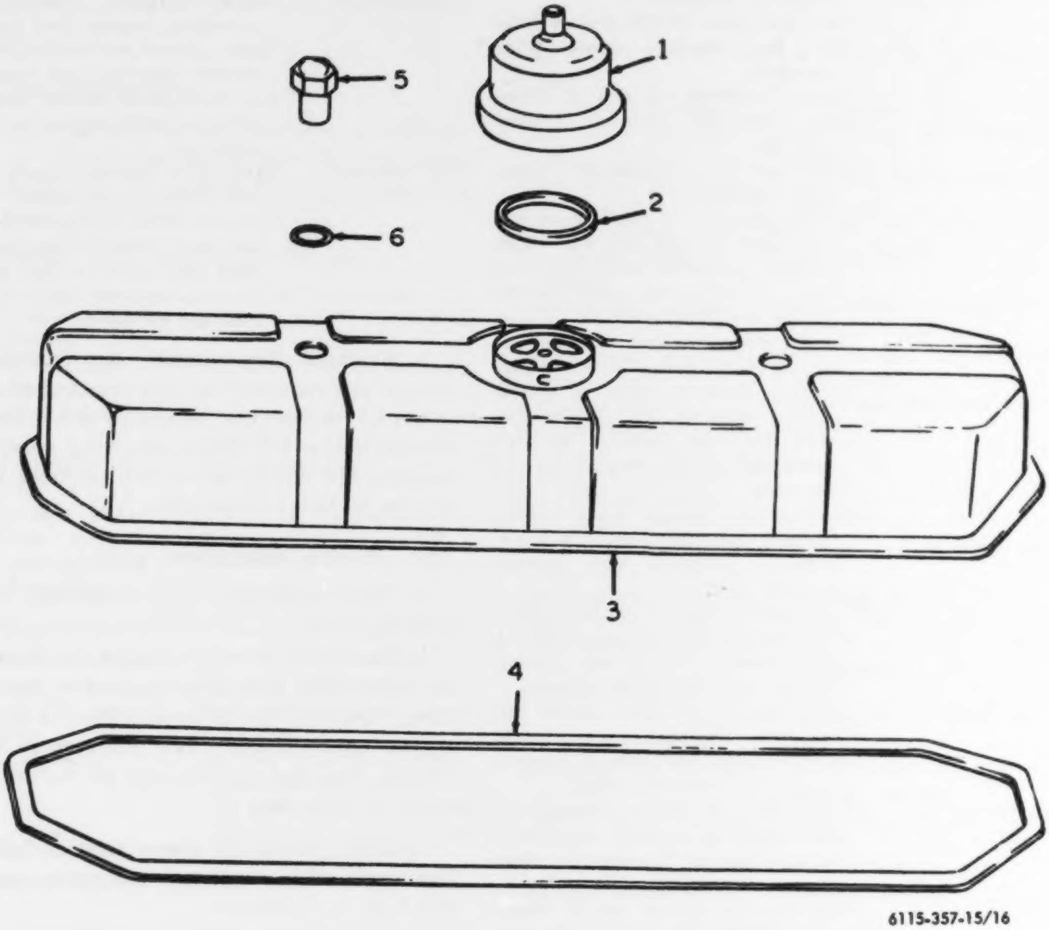
b. Intervals in Hours. Perform the following maintenance in the time indicated below:

Interval	*Service*
8 hours	Check crankcase oil level and add lubricating oil if necessary. Check oil pressure gage. Check and add coolant if necessary. If the coolant pump is leaking, replace seal. In freezing temperature check anti-freeze solution.



1 Cover assembly
2 Body assembly
3 Element assembly
4 Cap
5 Not used
6 Bracket
7 Intake manifold

Figure 15. Air cleaner.


1
5
2
6
3
4
6115-357-15/16

1 **Breather**
2 **Gasket**
3 **Cover**
4 **Gasket**
5 **Screw**
6 **Gasket**

Figure 16. Cylinder head cover and breather.

Interval	*Service*
8 hours (Continued)	Check fuel supply. (The engine uses approximately 48 gallons daily—24 hours.)
	Check generator charging rate.
100 hours	Check engine for loose connections and leaks in oil, fuel and coolant systems.
	Correct as necessary.
	Check and fill batteries. Check and clean battery cable connectors; grease if necessary.
	Check and clean the air cleaner filter (fig. 15). Replace element when necessary.
	Change crankcase oil and oil filter.
	Clean crankcase breather system. (fig. 16).
	Check radiator air passages. Clean when necessary.
250 hours	Remove end cover of engine generator and check brushes and slip rings. Remove excessive dust and dirt with a line free dry cloth. Do not disturb the brush settings.
	Check main generator mounting to be sure it is secure. If unit is performing properly, limit service to careful cleaning by blowing out loose dirt and particles so that brush rigging and brushes are not disturbed.
	Check wheel mount brake cables, fittings, and the pintle hook assembly. Lubricate with general purpose grease.
	Check and lubricate with light grade oil wheel mount friction points of hand brake, landing legs, towing coupler, and associated linkage.
300 hours	Inspect and, if necessary, adjust the fan belts. Replace when necessary.
	Inspect radiator and clean if clogged or scale formation is noted.
	Change fuel oil filter. Inspect the fuel supply tank and, if necessary, wash out thoroughly with clean fuel oil to remove all dirt and sediment.
	Check the fuel system, and if necessary, replace the water separator filter element. (fig. 24).
500 hours	Take compression pressure at cranking speed. If compression variation between cylinders exceed 25%, schedule the unit for overhaul.
	Check valve tappet clearance and reset if necessary.
	Clean injector nozzles and adjust spray.
	Check wheel mount tires for general condition. Tire pressure is 50 lbs.
1,000 hours	Adjust governor. Check, and if necessary, replace fuel injectors.
	Clean exhaust and intake ports, combustion chamber, and manifold.
	Lubricate panel latches and hinges with a light engine or machine grade oil.
As required	Check ether primer supply cylinder and replace when needed.
	For appearance and protection, clean and paint scratched surfaces. Place light film of oil or light grease on housing mounting bolts to prevent rust and corrosion.

c. Removal Procedures. No special techniques are required for the removal of components of the engine generator set. However, special notice for parts requiring special procedures are contained within particular paragraphs in this manual (sec. VI).

15. Engine Lubrication

a. Use lubricating oil conforming to MIL-L-2104,OE-30.

b. The filter element should be changed at the same time the oil is changed in the crankcase. Recheck the oil level after running the engine approximately five minutes to fill the filters. Use the dipstick and fill to the FULL mark on this gage.

Caution: **Do not fill above dipstick full mark. Too much oil in crankcase can cause engine to run hot.**

SECTION V
TROUBLE SHOOTING

16. General

This section provides information for diagnosing and correcting malfunctions or failure of the generator set or its components. The trouble shooting tabulation lists the malfunction, the probable cause and the possible remedy.

17. Troubleshooting

When the generator set operates unsatisfactorily or fails, locate the trouble by a process of elimination. Do not make more than one adjustment at a time.

a. Starter Will Not Crank Engine.

Probable cause	*Possible remedy*
Battery terminals loose or corroded.	Clean or tighten terminals.
Batteries discharged or defective.	Charge or replace batteries.
Battery polarity reversed.	Connect batteries for proper polarity.
Starter solenoid defective.	Replace solenoid.
Starter relay (K3) defective.	Replace starter relay.
Start-run-stop-switch (S2) defective.	Replace switch.

b. Engine Fails to Start.

Probable cause	*Possible remedy*
Fuel tank empty.	Fill tank with fuel.
Fuel valve in closed position.	Place fuel valve in proper position.
Day tank empty.	Fill day tank by placing start-run-stop switch in "RUN" position and hold protection bypass switch in "ON" position.
Fuel filters clogged.	Clean assembly and replace element.
Water separator clogged.	Clean assembly and replace element.
Dirt, gum, or water in fuel.	Drain foreign matter from fuel supply.
Air cleaner dirty.	Clean air cleaner.
Overspeed switch tripped.	Reset overspeed switch.
Air trapped in fuel lines.	Bleed fuel lines.
Defective valves.	Replace defective valves.
Injection nozzles leaking or dirty.	Clean, adjust, or replace nozzle.
Engine timing incorrect.	Correct timing.
Defective piston rings.	Overhaul engine.
Fuel injection pump defective.	Replace injection pump.
Dirty or defective electric fuel pumps.	Clean or replace electric fuel pump.

c. Engine Operating Erratically Or Lacks Power.

Probable cause	*Possible remedy*
Fuel filters dirty or clogged.	Clean filters and replace elements.
Water separator dirty or clogged.	Clean separator and replace elements.
Air in fuel lines.	Bleed fuel lines.
Air cleaner dirty or clogged.	Clean air cleaner.
Injection nozzles leaking or dirty.	Clean, adjust, or replace injection nozzles.
Dirt, gum, or water in fuel.	Drain foreign matter from fuel supply.
Defective valves.	Replace defective valves.
Engine timing incorrect.	Correct timing.

d. Engine Stops Suddenly.

Probable cause	*Possible remedy*
Fuel supply depleted.	Replenish fuel supply.
Dirty or defective electric fuel pump.	Clean or replace fuel pump.
Fuel systems clogged.	Clean fuel system.
Engine overspeeds.	Replace fuel injection pump.
High coolant temperature.	Refer to *e.* below, "Engine Overheats".
Low oil pressure.	Refer to *f.* below, "Low Oil Pressure".
Air cleaner clogged.	Clean air cleaner.
Defective fuel injection pumps.	Replace defective fuel injection pumps.
Leaking or broken fuel line.	Tighten or replace fuel lines.
Piston seizure.	Overhaul engine.
Bearing seizure.	Overhaul engine.

e. Engine Overheats.

Probable cause	*Possible remedy*
Lack of coolant.	Replenish coolant supply.
Engine thermostat defective.	Replace engine thermostat.
Leaking coolant system.	Correct leaks in system.
Clogged coolant system.	Clean and flush coolant system.
Defective radiator shutter and controls.	Replace defective parts.
Defective engine water pump.	Replace engine water pump.

Probable cause	*Possible remedy*
Ventilation insufficient.	Provide proper ventilation for generator set.
Fan belt loose or broken.	Tighten or replace fan belt.
Collapsed coolant hoses.	Replace hoses.
Dirt, oil, or insects in radiator air passages.	Clean radiator air passages.

f. Low Oil Pressure.

Probable cause	*Possible remedy*
Low oil level.	Add oil to proper level.
Defective oil pressure sensing unit.	Replace sensing unit.
Defective oil pressure gage.	Replace defective gage.
Clogged oil filter.	Clean oil filter and replace element.
Leaking or broken oil lines.	Tighten or replace defective oil lines.
Defective oil pump.	Replace oil pump.
Oil dilution due to defective pistons or piston rings.	Overhaul engine.
Improper grade of oil.	Change oil and refill with proper grade.

g. Engine Oil Consumption Excessive.

Probable cause	*Possible remedy*
Oil line leaks.	Correct defective oil lines.
Oil filter leaks.	Tighten line fittings; clean oil filter or replace element.
Improper grade of oil.	Drain and refill with proper grade of oil.
Defective pistons or piston rings.	Overhaul engine.
Defective oil seals.	Replace oil seals.

h. Engine Knocks Or Develops Sudden Noise.

Probable cause	*Possible remedy*
Low oil level.	Add oil to proper level.
Engine timing incorrect.	Correct timing.
High engine temperature.	Refer to *c.* above, "Engine Overheats."
Excessive carbon buildup.	Operate generator set at rated load.
Defective valves.	Replace defective valves.
Defective pistons and piston rings.	Overhaul engine.
Defective engine bearings.	Replace engine bearings.
Defective fuel injection pump.	Replace fuel injection pump.

i. Excessive Smoke In Exhaust.

Probable cause	*Possible remedy*
Air cleaner dirty.	Clean air cleaner.
Crankcase oil level too high.	Drain crankcase to proper level.
Defective valves.	Replace defective valves.
Excessive carbon build up.	Operate generator set at rated load.
Improper adjustment of fuel injection pumps.	Adjust injection pump.
Engine timing incorrect.	Correct timing.
Defective pistons or piston rings.	Overhaul engine.

j. Engine Overspeeds.

Probable cause	*Possible remedy*
Defective fuel injection pump governor.	Replace fuel injection pump.

k. Battery Charger Amp Meter Fails To Indicate.

Probable cause	*Possible remedy*
Defective amp meter.	Replace defective amp meter.
Defective shunt.	Replace defective shunt.

l. Battery Charging Amp Meter Fails To Show Charge.

Probable cause	*Possible remedy*
Battery lead loose.	Tighten battery leads.
Battery charger defective.	Replace battery charger.
Battery charger voltage regulator defective.	Replace defective voltage regulator.

m. Main Generator Fails To Build Up Voltage.

Probable cause	*Possible remedy*
Failed to flash field.	Flash field by moving S2 switch to "START" position.
Defective field flash relay (K5).	Replace K5.
Defective brushes.	Replace brushes.
Loose or broken field leads.	Tighten or replace field loads.
Shorted or open generator field.	Replace generator field coils.
Defective exciter.	Replace exciter.

n. Over Voltage Condition.

Probable cause	*Possible remedy*
Voltage adjustment rheostat set too high.	Adjust to proper setting.
Defective voltage adjustment rheostat.	Replace rheostat.
Defective voltage regulator.	Replace voltage regulator.
Open circuit in voltage sensing circuit.	Correct open circuit condition.

o. Undervoltage Condition.

Probable cause	*Possible remedy*
Voltage adjustment rheostat set too low.	Adjust to proper setting.
Low engine speed.	Adjust engine to rated speed.

Probable cause	*Possible remedy*
Defective brushes.	Replace brushes.
Loose or broken field leads.	Tighten or replace field leads.
Shorted or open generator field.	Replace generator field coils.
Defective exciter.	Replace defective exciter.

p. Main Generator Voltage Drops On Load Application.

Probable cause	*Possible remedy*
Defective voltage regulator.	Replace defective voltage regulator.

q. Generator Frequency Fluctuates Or Drifts.

Probable cause	*Possible remedy*
Engine speed erratic.	Refer to *c.* above, "Engine Operating Erratically Or Lacks Power."

r. Slip Ring Sparking.

Probable cause	*Possible remedy*
Improper seating of the brushes.	Seat brushes properly.

s. Discolored Slip Rings.

Probable cause	*Possible remedy*
Excessive sparking.	Seat brushes properly.

t. Excessive Hum.

Probable cause	*Possible remedy*
Defective bearing.	Replace bearings.
Rotor out of balance.	Replace rotor.
Short circuit.	Correct short circuit condition.

u. Main Output Circuit Breaker Opens Or Fails To Close.

Probable cause	*Possible remedy*
Undervoltage condition.	Refer to *o* above, "Undervoltage Condition".
Short circuit.	Correct short circuit condition.
Defective circuit breaker.	Replace circuit breaker.

v. Improper Meter Reading Or Indication.

Probable cause	*Possible remedy*
Component of circuit meter is defective or not functioning properly. Loose connections.	Locate meter in circuit diagram. Trace wiring, check connections; replace or splice broken wires, replace indicated faulty part. Check actuating voltage or condition for meter. If circuitry is correct or condition (temperature, oil pressure or current) is satisfactory check circuit with external meter to see if meter is defective. Replace defective meter.

w. Convenience Receptacle Fuse Burns Out.

Probable cause	*Possible remedy*
Receptacle overloaded, short circuit in load.	Adjust load, replace defective fuse.

x. Excessive Vibration.

Probable cause	*Possible remedy*
Alignment of generator set.	Tighten mounting bolts to base and engine.

SECTION VI
REPAIR

18. General

This section covers the repair of components that are repairable in the generator set. Methods for disassembly and the repair of components are given below. Engine components are arranged in alphabetical order for easy reference in each of two parts in which they are divided. The section is divided as follows:

a. Engine External Components.
b. Engine Internal Components.
c. Main Generator.
d. Control Group.
e. Wheel Mount.

Fits and tolerances are listed at the end of this section.

Note. All components of the generator set should be repaired by qualified technicans.

19. Engine External Components

a. Battery Charging Generator (fig. 17 *and* 18). A periodic inspection should be made of the charging circuit. The intervals between these checks will vary, depending upon the type of service. Dirt, dust and high speed operation are factors which will contribute to increased wear of the bearings, brushes, and associated parts.

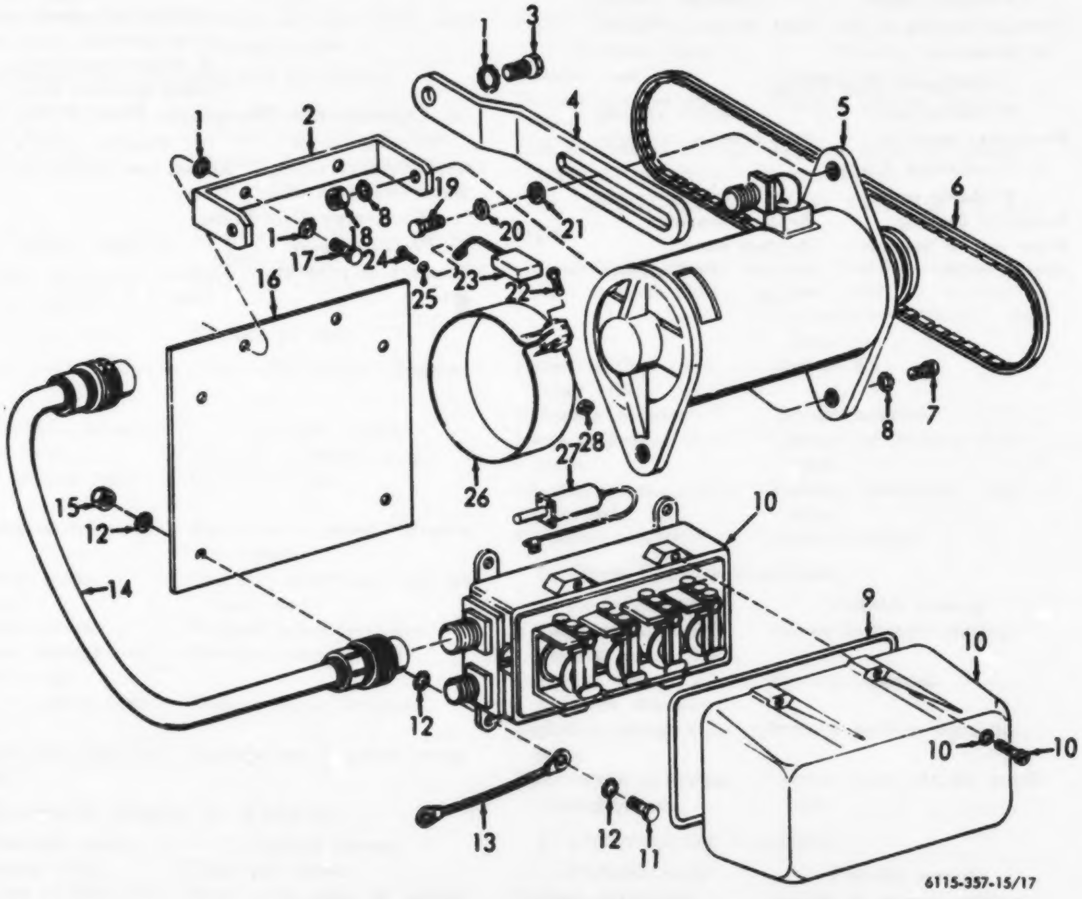


Figure 17. Battery charging generator and regulator.

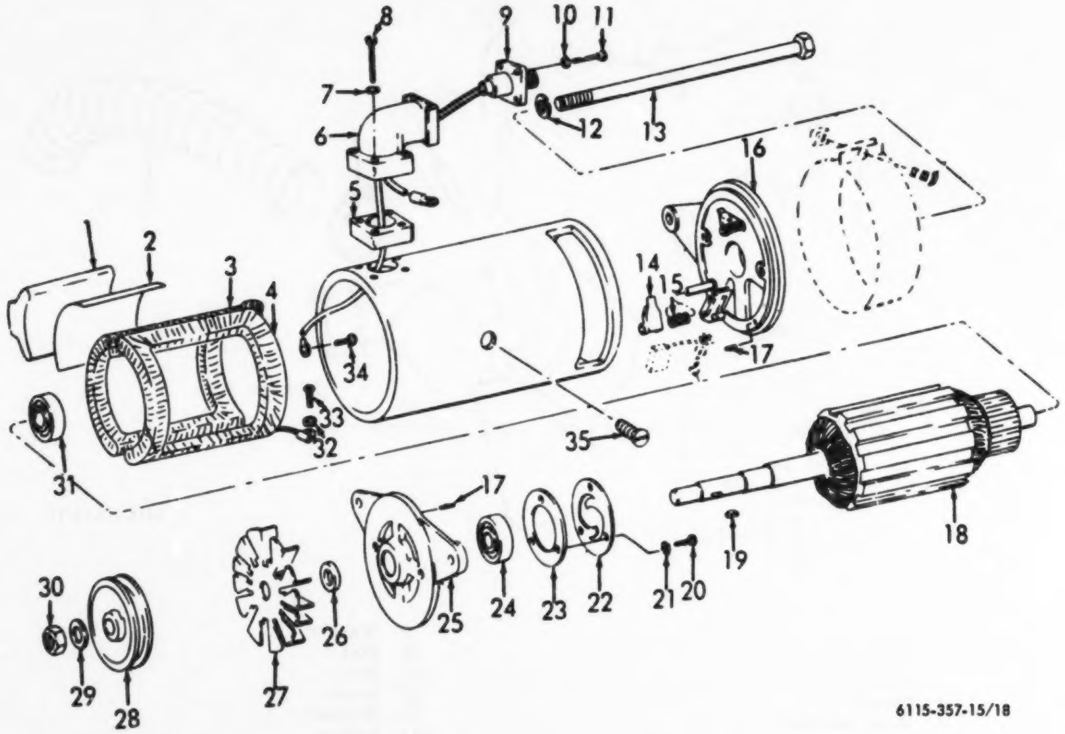
Refer to Figure 17 on opposite page.

1	Washer
2	Bracket
3	Screw
4	Strap
5	Generator
6	Belt
7	Screw
8	Washer
9	Gasket
10	Regulator
11	Screw
12	Washer
13	Strap
14	Cable assembly
15	Nut
16	Bracket
17	Screw
18	Nut
19	Bolt
20	Washer
21	Washer
22	Screw
23	Brush Set
24	Screw
25	Washer
26	Cover
27	Capacitor
28	Nut

(1) *Wiring.* A visual inspection should be made of all wiring to insure that there are no broken wires and that all connections are clean and tight. Special attention should be paid to the ground connections at the battery and generator.

(2) *Commutator.* If the commutator is dirty or discolored, it can be cleaned by holding a piece of Number 00 sandpaper against it while turning the armature slowly. Blow the sand out of the generator after cleaning the commutator. If the commutator is rough or worn, the generator should be removed from the engine, the armature removed and the commutator turned down.

(3) *Brushes.* The brushes should slide freely in their holders. If the brushes are oil soaked or if they are worn to less than one-half their original length, they should be replaced.



1	Shoe
2	Insulation
3	Coil
4	Coil
5	Spacer
6	Elbow
7	Washer
8	Screw
9	Receptacle-lead
10	Washer
11	Screw
12	Washer
13	Bolt
14	Arm
15	Spring
16	End Bell
17	Pin
18	Armature assembly
19	Key
20	Screw
21	Washer
22	Ring assembly
23	Retainer
24	Bearing
25	Head
26	Spacer
27	Fan
28	Pulley
29	Washer
30	Nut
31	Bearing
32	Washer
33	Screw
34	Screw
35	Screw

Figure 18. Battery charging generator.

If the generator does not function properly after the above check, the generator and the regulator should be replaced and turned in for repair.

b. Cooling System (fig. 10).

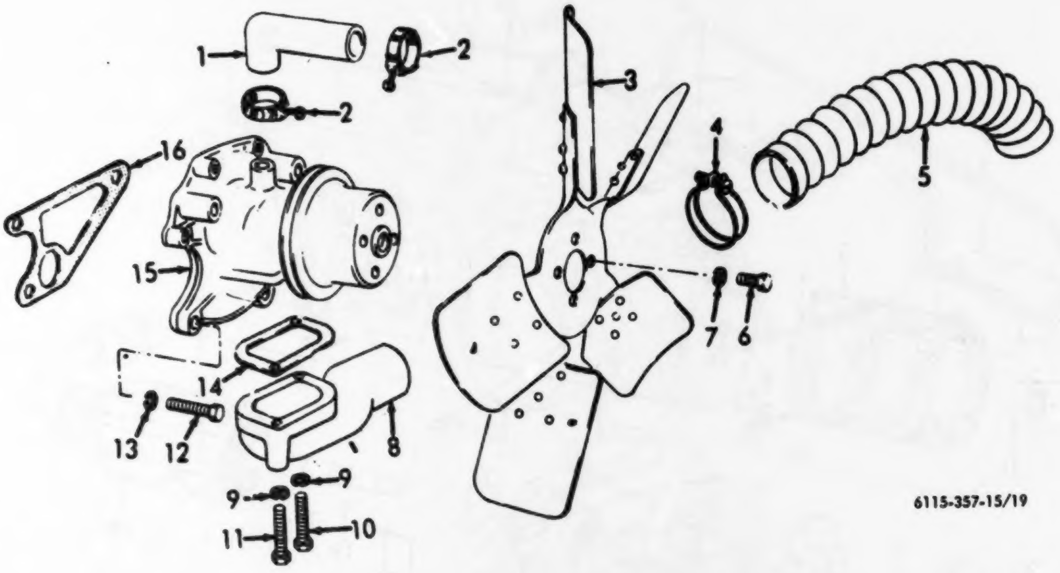
(1) The best method for care of the cooling system is to clean and flush the system periodically. Use good rust and corrosion preventive between cleaning periods.

(2) Exhaust gas leakage between the cylinder head and the gasket also results in corrosion if exhaust gases discharge into the water, combining to form a variety of acids such as carbonic, nitric, and sulphuric, all supporting eletrolytic corrosion. It is, therefore, important that the cylinder head stud nuts be drawn down at regular and frequent intervals to prevent exhaust gases from leaking into the water jacket.

(3) Air leaks around the hose connections and through the coolant pump should be prevented, since oxygen is a major factor in promoting corrosion. Check the hose connections frequently for air leaks.

(4) Use a good neutralizer in the cooling system.

c. Coolant Pump and Fan Assembly (figs. 19 and 20). The coolant pump may be removed from the engine after removing the coolant inlet hose, bypass hose and fan blade. Then, remove the coolant pump mounting screws and lift the pump away from the engine.



1	Hose
2	Clamp
3	Fan
4	Clamp
5	Hose assembly
6	Bolt
7	Washer
8	Elbow
9	Washer
10	Bolt
11	Bolt
12	Screw
13	Washer
14	Gasket
15	Pump assembly
16	Gasket

Figure 19. Water pump and fan.

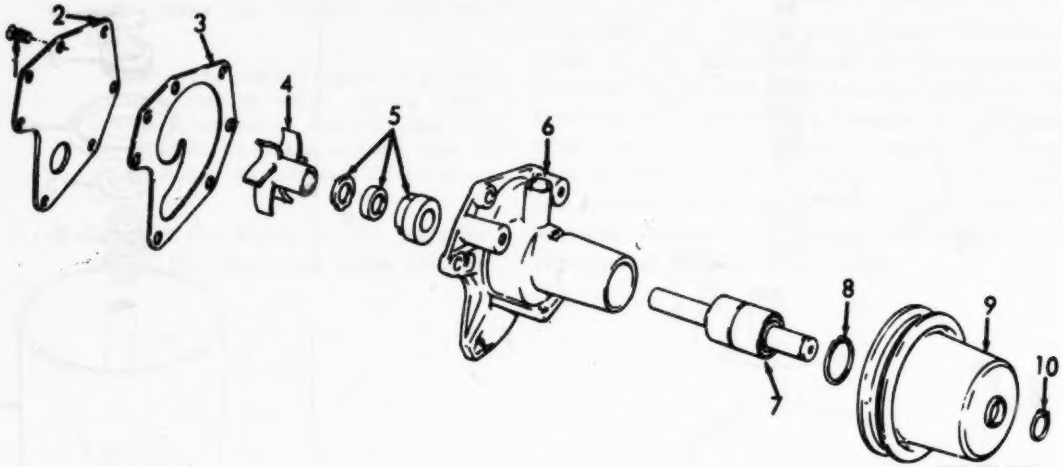
(1) ***Disassembly.***

(a) **Remove the snap ring and pull the fan pulley hub from the pump shaft and remove the snap ring.**

(b) **Remove the screws from the coolant pump to cover plate and remove the plate and gasket.**

(c) **Place the front of the pump on a suitable support in an arbor press and press the shaft and bearing assembly out of the pump body and impeller.**

(d) **Press the seal out of the pump body. The shaft and bearing assembly is one unit and no attempt should be made to disassembly these parts.**



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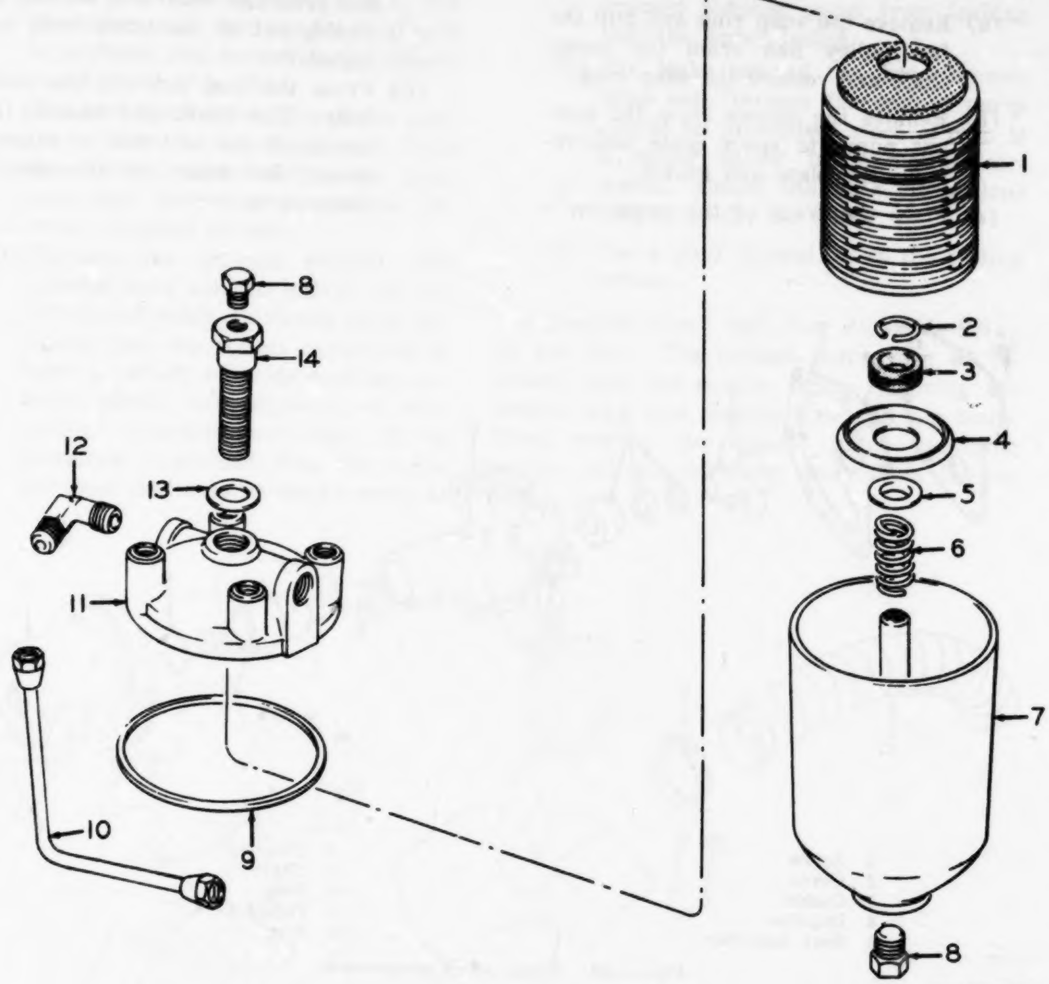
1 Screw
2 Cover
3 Gasket
4 Impeller
5 Seal assembly
6 Housing
7 Shaft
8 Ring
9 Pulley
10 Ring

Figure 20. Water pump components.



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1	Filter element
2	Washer
3	Washer
4	Cover
5	Gasket
6	Spring
7	Body
8	Screw
9	Washer
10	Line
11	Cap
12	Elbow
13	Washer
14	Bolt

Figure 21. Primary and secondary fuel filter.

(2) *Cleaning and Inspection.* Wash and clean all parts thoroughly; inspect for wear and damage. It is advisable to reface the seal surface of the impeller if it is grooved or otherwise marked. Put a coating of grease on the seal surface before starting reassembly of the pump.

(3) *Reassembly.*

(a) Press the new seal into the pump body.

Caution: **PRESS ON THE OUTER FLANGE OF THE SEAL TO AVOID DAMAGING THE SEAL.**

(*b*) **Press the shaft and bearing assembly into the body.**

Caution: **PRESS ONLY ON THE OUTER BEARING FACE OF THE BEARING AND NOT ON THE END OF THE SHAFT.**

(*c*) **Install the snap ring. Supporting the pump shaft on the outer shaft end, press the impeller onto the shaft.**

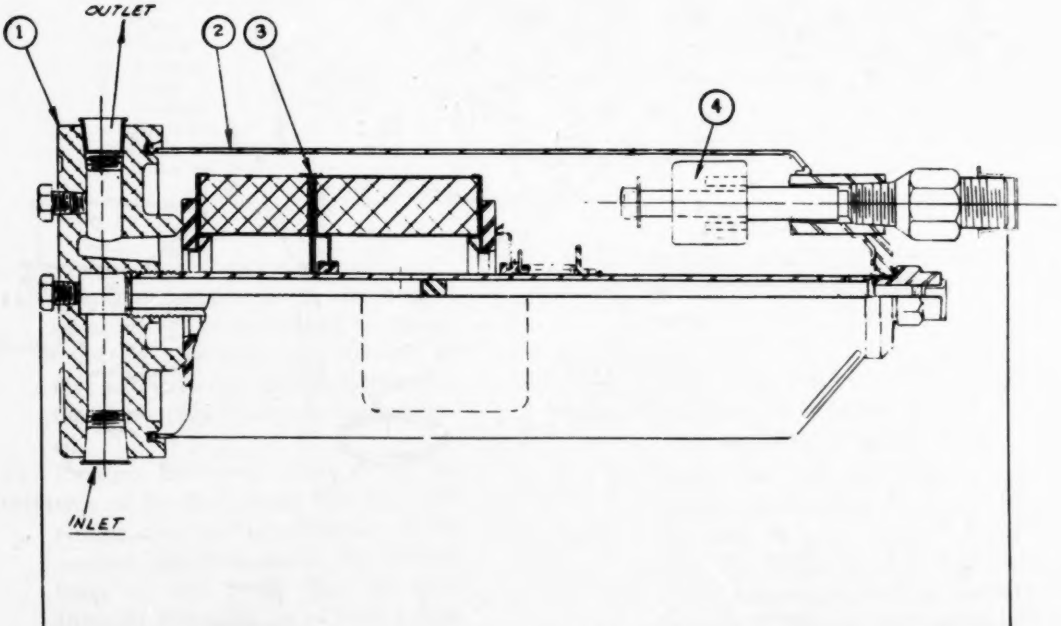
Note. The impeller should be pressed on to a position which permits ".010" clearance between a straight edge and the impeller when the straight edge is placed across the rear face of the pump body.

(*d*) **Support the pump on the impeller end of the shaft and press the fan drive pulley on to the shaft and install the snap ring.**

(*e*) **Install a new cover gasket and the pump cover, with the screws as removed.**

(*f*) **Test the rotation of the fan to see that it does not bind or have any excessive resistance. When installing the coolant pump always use a new gasket and tighten the attaching screws evenly and alternately to prevent possible damage.**

d. Fuel Oil Filter and Water Separator (figs. 21 *and* 22*).* **Because of the extremely accurate construction of various parts of the fuel injection system, the engine is equipped with two fuel filters and a water separator unit to remove dirt particles and water from the system. These units are equipped with removable elements which must be inspected and replaced at regular intervals.**

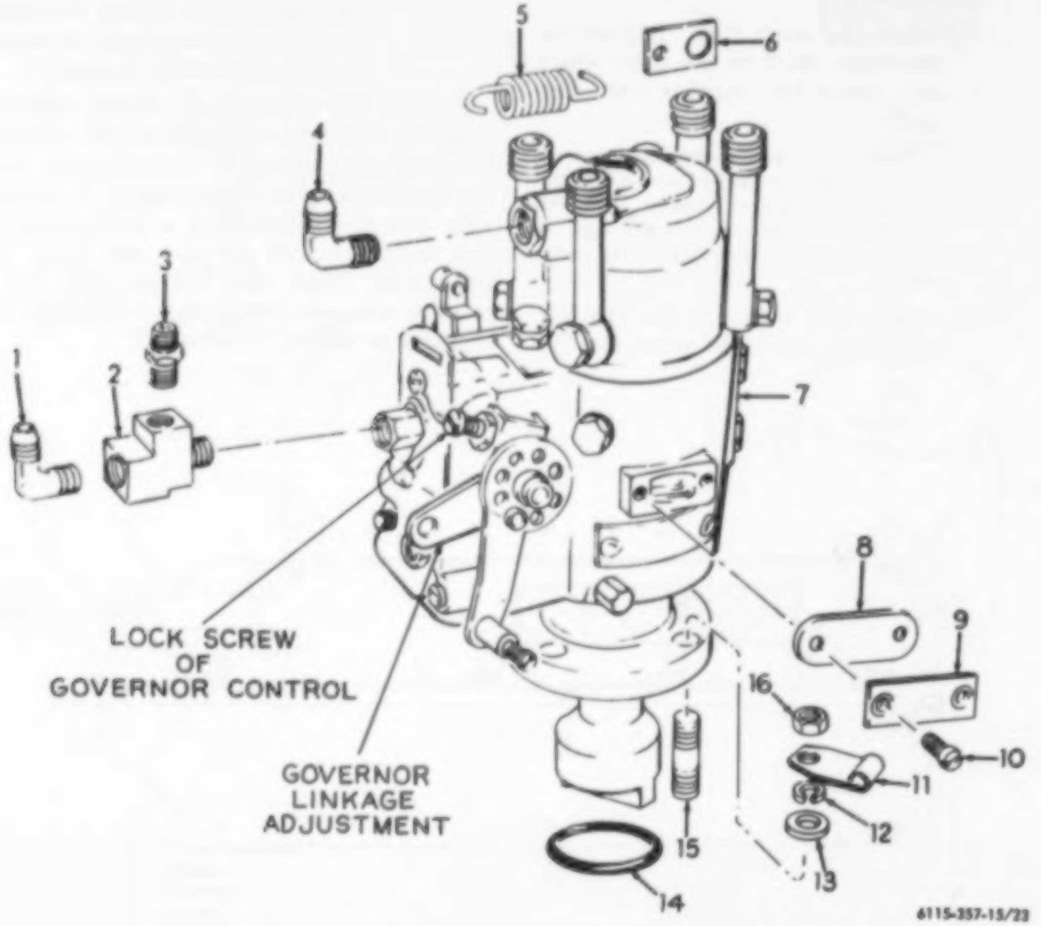


1 **Head assembly**
2 **Body assembly**
3 **Cartridge filter assembly**
4 **Float assembly**

Figure 22. Water Separator.

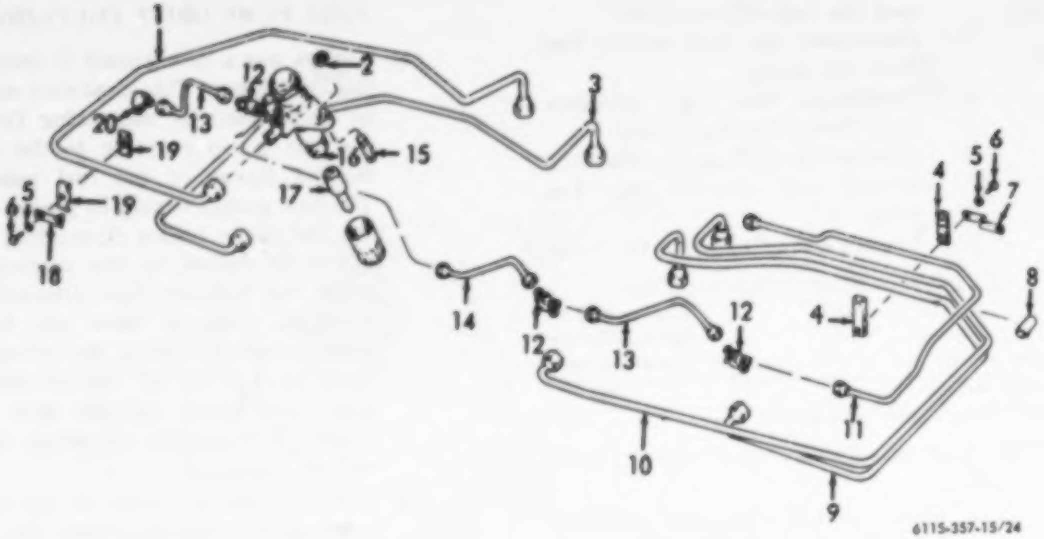
e. Fuel Injection Pump (figs. 23 and 24). The injection pump is completely lubricated by fuel oil which is then bypassed or returned to the supply tank. The fuel injection pump injects fuel into the engine cylinders in a clockwise rotation order—1, 2, 4, 3. The fuel injection pump is considered a single, opposed plunger, inlet metering, distributor type pump. It meters and supplies liquid fuel oil through nozzles into the engine cylinders.

Note. Fuel injection pump or fuel nozzle repairs should not be attempted by anyone other than qualified personnel who are thoroughly familiar with fuel injection systems.



1	Elbow
2	Tee
3	Adapter
4	Elbow
5	Spring
6	Plate
7	Pump
8	Plate
9	Plate
10	Screw
11	Clamp
12	Washer
13	Washer
14	Packing
15	Stud
16	Nut

Figure 23. Fuel injection pump.



1	Tube assembly
2	Nut
3	Tube
4	Clamp
5	Washer
6	Screw
7	Bracket
8	Grommet
9	Tube assembly
10	Tube assembly
11	Tube assembly
12	Tee
13	Line assembly
14	Line assembly
15	Stud
16	Holder assembly
17	Nozzle
18	Bracket
19	Clamp
20	Elbow

Figure 24. Fuel injection system.

(1) *Fuel Injection Pump Removal.*

(a) Clean and wash down the engine adjacent to the fuel injection equipment to eliminate any chance of dirt entering the fuel injection system when the lines are disconnected.

(b) Remove the cover plate from the side of the fuel pump and turn the engine over in the direction of its normal rotation until the timing lines on the pump can be seen through this opening. Check to see that the piston of the cylinder to which the injection pump in timed is at the proper degree before top center. ("Timing Chart" below.) This can be determined as follows:

1. Remove the injection nozzle from the cylinder to which the pump is timed and "feel" the compression by placing a thumb over the nozzle opening, as the crankshaft is rotated.

2. Check the timing mark on the flywheel in relation to the flywheel housing timing pointer.

3. With the fuel injection pump timing marks exactly alined the flywheel degree mark aligned with the timing pointer indicates the exact pump timing. Record this information for reference when reinstalling the fuel injection pump.

(c) Remove the pump from the engine as follows:

1. Disconnect the fuel supply line, transfer pump to filter line, and filter to pump line; also disconnect the leak-off manifold.

2. Disconnect the fuel return line from the pump.
3. Disconnect the high pressure lines from the fuel pump.
4. Remove the fuel pump attaching screws and remove the fuel pump.
5. Inspect the drive parts for wear.

INJECTION PUMP TIMING CHART

Engine model	*Timing B. T. C. flywheel degrees* Speed advance
Vertical mounted	*32°

* Pump without speed advance feature.

(2) *Fuel Injection Parts (Timing) Installation.*

(a) When timing the fuel injection pump, use the following procedure:

(1) Check that the injection pump timing marks are exactly alined.

(2) Check that the flywheel degree mark is alined with the timing pointer exactly as indicated and recorded during removal of injection pump.

(3) Time the pump to the engine on cylinder 1 as indicated in *(b)* below.

(b) The fuel pump is driven from the oil pump drive gear through a tongue and groove type coupling. The tongue and groove of the coupling parts are slightly off center to prevent incorrect installation of the fuel pump. The tongue and groove are offset away from the camshaft when the engine is properly spotted with Number 1 cylinder at top dead center in firing position. The groove in the top of the oil pump gear is parallel with the engine camshaft when the flywheel mark is on dead center.

Caution: **IT IS IMPORTANT THAT A MINIMUM CLEARANCE OF .060 INCHES (1/16) BE MAINTAINED BETWEEN THE OIL PUMP DRIVE GEAR AND THE FUEL PUMP DRIVE COUPLING.**

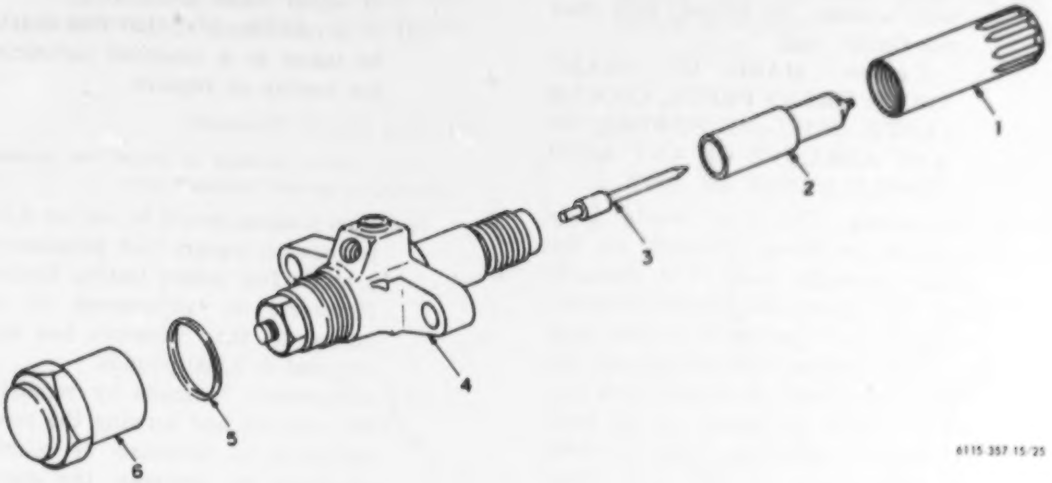
(c) Always use a new gasket to install the fuel pump. This clearance may be determined by measuring from the fuel pump coupling to the attaching flange of the fuel pump. The new gasket should be placed on the fuel pump before measuring, or add 1/32 inches to the measurement and subtract this dimension from the distance from the fuel pump attaching face of the cylinder block to the top of the oil drive gear. Additional gaskets may be added, if necessary, to obtain the correct clearance.

(d) The first step in installing the fuel pump is to locate the proper degree mark on the flywheel and line it up with the mark or pointer on the engine and plate. To determine that the proper piston is in the correct position, remove the fuel nozzle from the cylinder to which the injection pump is to be timed, and "feel" the compression by placing a thumb over the nozzle opening, as the crankshaft is rotated.

(e) Turn the fuel pump coupling so that the marks are in view and assemble the fuel pump to the cylinder block and coupling. Tighten the attaching nuts sufficiently to hold the pump in place and still allow it to be turned.

f. Fuel Nozzle and Holder Assembly (fig. 25).

(1) *Disassembly.* The fuel nozzle and holder assembly should be clamped in a vise preparatory to disassembling. Clamp in holding the assembly in jaws of vise. The fuel nozzle body and fuel nozzle pintle are not interchangeable with similar parts of other assemblies and must be used as pairs as originally furnished.



1 Nozzle body retaining nut
2 Fuel nozzle body
3 Fuel nozzle pintle
4 Holder assembly
5 Pressure adjustment cap gasket
6 Pressure adjustment cap

Figure 25. Fuel injection nozzle.

Note. Do not mix these parts. Keep them in sets.

(2) Cleaning the spray nozzles is necessitated by the following:

(a) Dirt or foreign matter in the fuel oil which is not removed by the fuel strainers, acid and gum in particular.

(b) By an overheated engine and the spray nozzles causing the fuel oil in the nozzles to decompose or cake around the pintle stem of the valve, spray hole and face of the nozzle.

(c) Acid in the fuel oil etching or corroding the nozzle valve and body. This type of fuel should never be used under any circumstances. It will ruin the pumps and nozzles. Fuel oil which is contaminated with acid may be detected by dipping one end of blue litmus paper in the oil for a few seconds. If acid is present in the oil, the litmus paper will turn pink.

(3) *When to Clean the Spray Nozzles.*

(a) When the engine exhaust has increased the amount of black or dark smoke.

(b) Loss of power accompanied with foul exhaust or increased leakage of fuel through the bypass leakoff of the spray nozzle.

(c) When the engine runs rough or "ragged".

(d) Irregular fuel knocks.

(e) Engine missing on one or more cylinders continuously.

(4) *Cleaning the Spray Nozzles.*

(a) The most important part of spray nozzle cleaning, testing and examination is CLEANNESS. Spread some clean paper on the work area and have available a clean open container of clean fuel or kerosene, approximately one joint is sufficient. Also, have available a supply of soft (not fluffy), dry, clean, wiping cloths, a clean squirt can of lubricating oil or a jar of vaseline.

(b) Spray nozzles should be cleaned by first soaking them in kerosene or clean fuel oil to soften the dirt. The interior of the body can be cleaned with a small strip of wood dipped in the cleaning oil and the spray hole with a pointed piece of wood.

The nozzle valve should be rubbed with a clean, oil soaked, soft (but not fluffy) rag.

Caution: **HARD OR SHARP TOOLS, EMERY PAPER, CROCUS CLOTH, GRINDING POWDER OR ANY ABRASIVE OF ANY KIND SHOULD NEVER BE USED.**

(5) *Reassembly.* The fuel nozzle body must be positioned correctly on the holder assembly when it is reassembled. Two types of indexing are used; one type has two marks which must be aligned when reassembled and the other has a locating dowel which correctly locates the nozzle on the holder. Before assembling, wash and rinse all parts carefully and have them perfectly clean, coat with good clean lubricating oil or vaseline so that the valve resolves freely. Tighten the nozzle retaining nut up hard.

(6) *Tests.*

(*a*) Testing the spray nozzle can be done by running the engine with the spray nozzle attached to the fuel delivery pipe, but not installed in the engine. Occasionally set the throttle in full load position momentarily, while observing the spray and possible leakage.

(*b*) Each nozzle tip has four minute orifices from which fuel is sprayed simultaneously during the injection period. The spray from each orifice should be smooth and even, that is, free from uneven branches or streams and the same thickness of oil spray all around the oil spray cone as observed 2 to 5 inches from the nozzle. Unevenness or roughness of the stream indicates a dirty nozzle hole which must be cleaned with the proper tools.

(*c*) An "after dribble" or "drool" of oil out of the nozzle after the spray is completed indicates that the nozzle hole and pintle are not clean and should be polished as above. Be sure both the valve and barrel are perfectly clean, with no lint, dirt or foreign substance on the surface of either when assembling.

(*d*) It is recommended that fuel nozzles be taken to a qualified technician for testing or repairs.

(7) *Fuel Nozzle Pressure.*

Note. Never attempt to adjust the pressure without the proper testing fixture.

(*a*) Fuel nozzles should be set for 2,750 pounds per square inch pressure on a static fuel nozzle testing fixture. However, no adjustment is required if this pressure has only dropped to 2,500 pounds.

(*b*) Adjustment is made by removing the cap nut and turning the screw clockwise to increase or counter clockwise to decrease the spring tension, thus raising or lowering the pressure.

(*c*) New nozzles and holder assemblies are set at 2,750 pounds to compensate for the setting of the spring in the first few hours runnings.

(8) *Fuel Nozzle and Holder Installation.*

(*a*) The fuel nozzle and holder assembly must be handled with extra care at all times and particularly so while being assembled in the engine, in order to prevent damaging the assembly.

(*b*) The assembly securing nuts must be tightened evenly to prevent cocking of the assembly when installed.

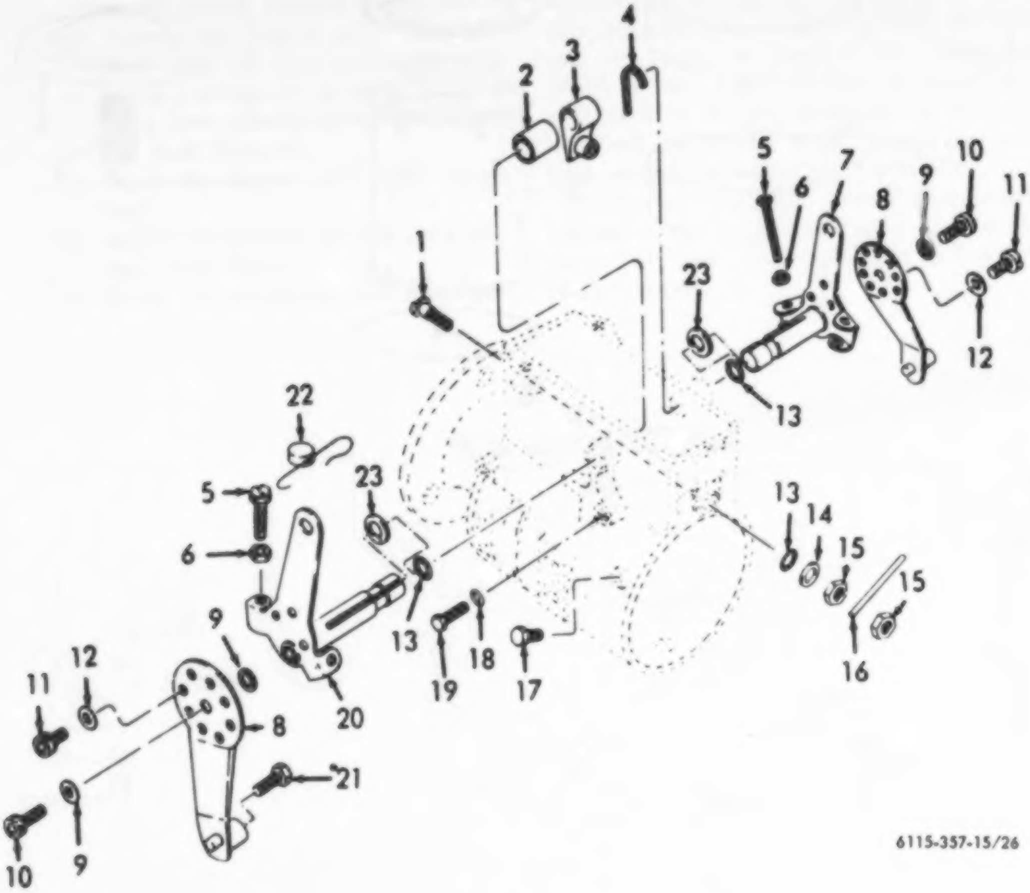
(*c*) Uneven tightening of the securing nuts may distort the nozzle holder or nozzle tip and cause engine misfiring or possible destruction of the complete assembly.

(*d*) The use of a torque wrench is strongly recommended to progressively tighten the securing nuts to 25 to 30 foot pounds torque to insure equal tension on sides of the nozzles and holder assembly flange.

g. Governor (figs. 24 and 26).

(1) The governor is an integral part of the fuel injector pump assembly. It is equipped with minimum and maximum speed regulating adjusting

screws and a set tolerance under varying load conditions. When malfunctions occur, which indicate the governor is defective, the pump assembly and governor must be replaced as a unit.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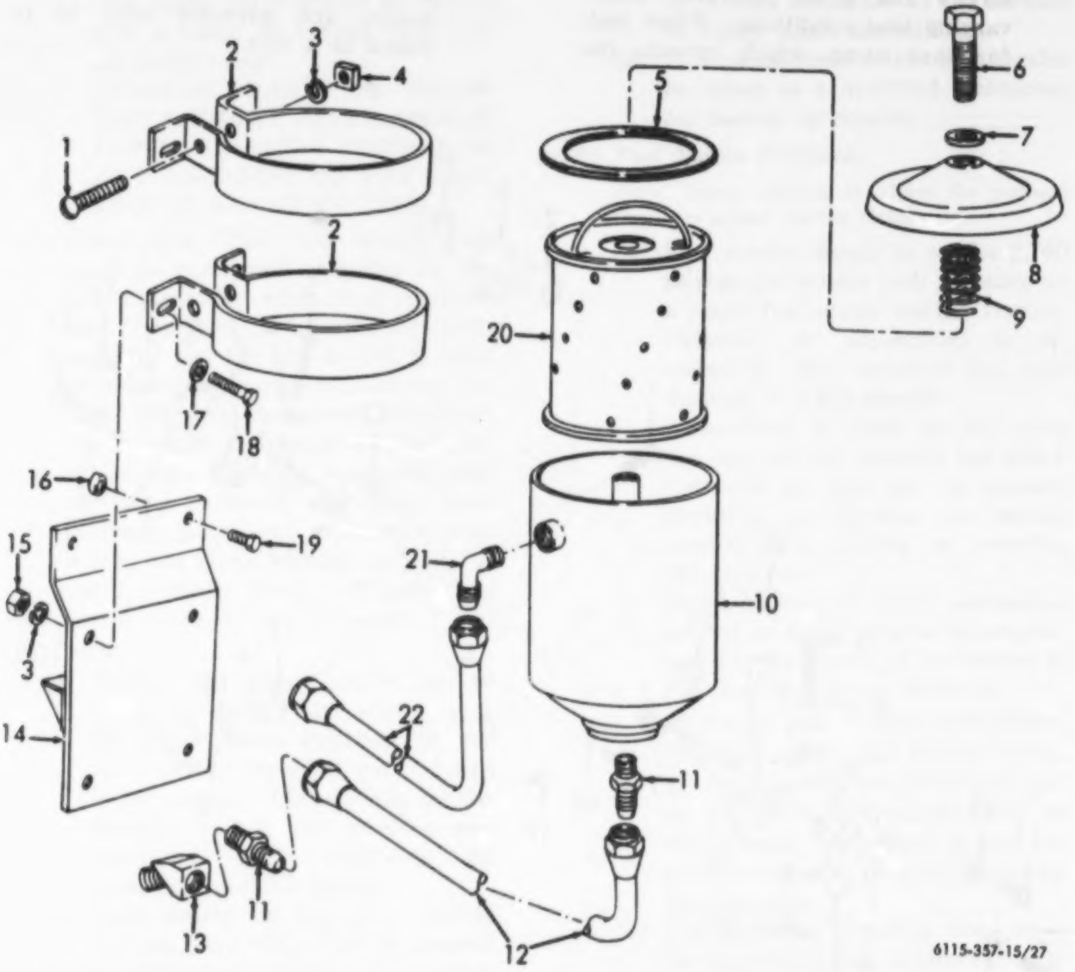
1	Screw
2	Spacer
3	Lever assembly
4	CAM
5	Screw
6	Nut
7	Shaft assembly
8	Arm assembly
9	Washer
10	Screw
11	Screw
12	Washer
13	Packing
14	Washer
15	Nut
16	Rod
17	Bolt
18	Washer
19	Screw
20	Shaft assembly
21	Screw
22	Lead
23	Washer

Figure 26. Governor linkage.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1	Screw
2	Strap
3	Washer
4	Nut
5	Washer
6	Bolt
7	Washer
8	Cover
9	Spring
10	Filter
11	Adapter
12	Line assembly
13	Elbow
14	Bracket
15	Nut
16	Spacer
17	Washer
18	Bolt
19	Screw
20	Filter element
21	Elbow
22	Line assembly

Figure 27. Oil filter.

(2) To set for full load speed, the full load adjusting screw should be set to permit carrying a full load at the frequency of 400 Hertz or 1,846 rpm. To adjust the engine speed for 1,846 rpm, 400 Hertz, proceed as follows:

(a) Loosen the locking nut and withdraw the full load adjusting stop screw sufficiently to give the operating lever enough movement in the full load direction.

(b) Start the engine and apply rated load.

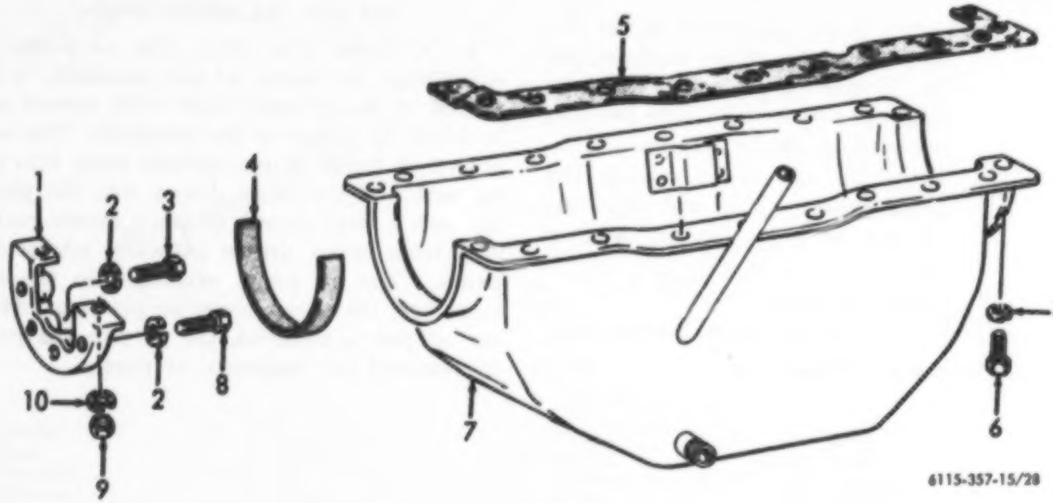
(c) Adjust the throttle setting for 1,846 rpm (400 Hertz).

(d) Screw the adjusting stop screw inward until contact is made. Screw the locking nut against the plate to hold the setting.

(e) Install the cover and seal.

h. Oil Filter (fig. 27). The oil filter should receive regular and careful attention. A definite schedule for replacement of the element can be found in Section IV, Maintenance. When a new filter element is installed, add sufficient oil to the crankcase so that the oil level will be correct after the engine has run long enough to refill the filter.

i. Oil Pan (fig. 28). The oil pan covers the bottom of the crankcase and is used as an oil sump. A drain plug is located in the bottom of the oil pan.



1 Adapter
2 Washer
3 Screw
4 Rubber strip
5 Gasket
6 Screw
7 Pan
8 Screw
9 Nut
10 Washer

Figure 28. Oil pan and adapter.

(1) *Removal.*

(a) Drain the crankcase oil.

(b) Remove the cap screws from the oil pan and lift the oil pan away from the engine.

(2) *Installation.*

(a) Clean the oil pan thoroughly; also, remove the gaskets from the oil pan and cylinder block.

(b) Inspect the inside of the pan and the engines for loose nuts, screws, cotter pins, lock wires, etc.; if necessary tighten or replace.

(c) Remove the front and rear oil pan adapters and clean the gasket surfaces.

(d) Cement the new oil pan side gaskets to the cylinder block.

(e) Install the front and rear oil pan adapters.

Note. If new end plate or gear housing gaskets have been used, it is necessary to cement the oil pan gaskets in place and install the adapters before tightening the end plate and timing gear housing attaching screws.

(f) Cement the oil pan front and rear seals in the oil pan with Armstrong No. D-200 adhesive, if available, (Hercules part No. 255215-A) so that each end of the seal extends the same distance above the oil pan attaching flange.

Note. The adhesive sets quickly and the seals should be inserted at once. Do not cut off the ends of the seals.

(g) Apply some lubricating oil to the oil pan adapter gasket surfaces, put the oil pan in place and carefully start all screws. Be sure the lock washers are on the screws.

(h) Draw up all screws evenly and progressively. This will allow the oil pan to center on the adapter blocks.

(i) Install the drain plug.

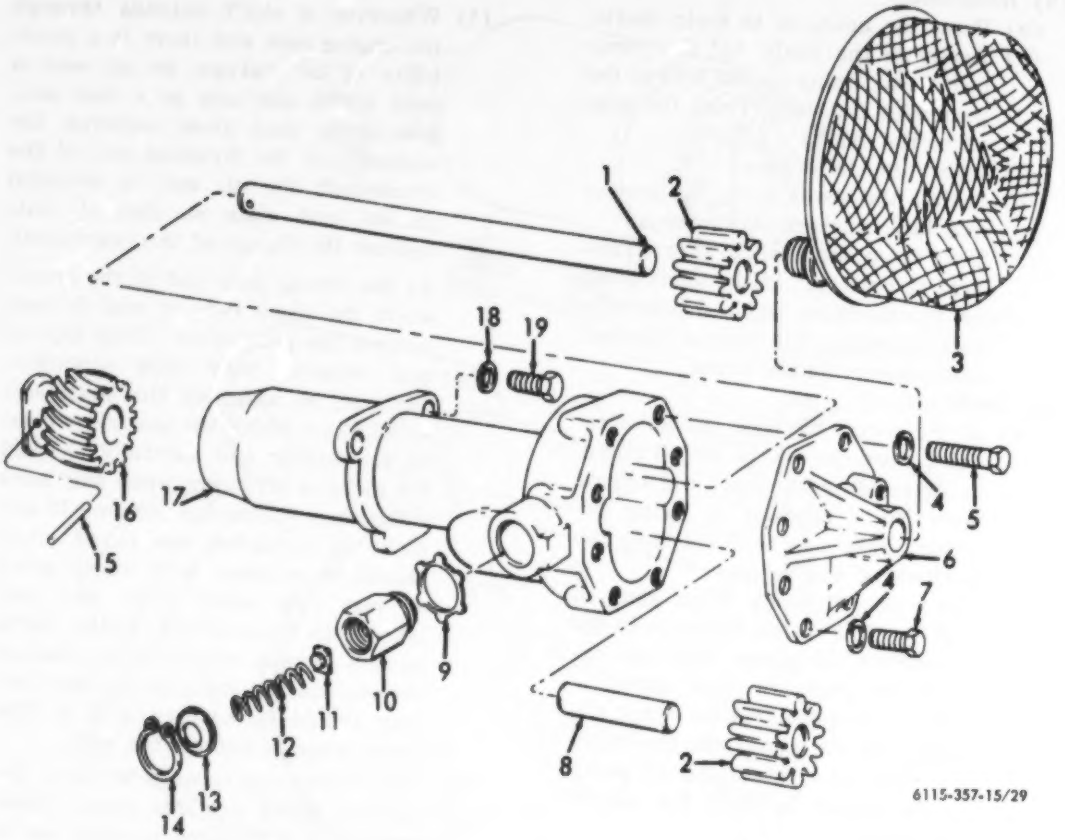
(j) Refill with oil to the correct level.

j. Oil Pressure Adjustment.

(1) The oil pressure is automatically controlled or regulated by a compression type spring which controls a relief or bypass valve. This device is assembled to the cylinder and controls the oil pressure through a predetermined spring pressure and, therefore, no adjustment of the oil pressure is required. There is also a high pressure safety relief valve assembled to the oil pump which prevents the buildup of excessive oil pressure.

(2) The oil pressure regulator is calibrated to maintain a pressure of 30 to 45 pounds in the system. This will vary somewhat with the temperature of the oil, the OE weight of the oil, and with the engine speeds.

k. Oil Pump (fig. 29). The oil pump located near the center of the camshaft, is attached to the cylinder block with screws and is driven by a gear on the camshaft. The lower end of the oil pump extends down into the oil pan, and the oil is drawn into the pump through a large screen, which prevents coarse dirt from being drawn into the lubricating pump. The oil pump extends into the oil; therefore, the pump needs no priming. After the oil pan is removed, the oil pump is readily removed for inspection or repairs.



1	Shaft
2	Gear
3	Strainer
4	Washer
5	Screw
6	Cover
7	Screw
8	Pin
9	Washer
10	Holder
11	Piston
12	Spring
13	Retainer
14	Ring
15	Pin
16	Gear
17	Body
18	Washer
19	Screw

Figure 29. Oil pump.

(1) *Removal.*

(*a*) Remove the oil pan.

(*b*) Turn the engine so that the No. 1 piston is in the firing position. This may be noted from the position of the valves or from the position of the cams on the camshaft.

***Note.* The overspeed switch drive must be removed before attempting to remove the oil pump.**

(c) Remove the screws from the oil pump flange and pull the oil pump from the engine.

(2) *Disassembly.*

(*a*) Remove the drive gear pin and pull the gear from the shaft.

***Note.* Puller must be under the gear and not under the fuel pump drive coupling flange.**

(*b*) Remove the screws and washers from the pump gear cover and remove the cover.

(*c*) Remove the gears and shafts. The gears may be pressed from their respective shafts, if necessary.

(3) *Reassembly.*

(*a*) Press the gears on to their shafts.

(*b*) Assemble the shaft in the pump body; and, lining up the hole in the gear with the shaft, press the gear on to the shaft.

(*c*) Insert the drive gear.

(*d*) Install the cover with the screws and lock washers as removed.

(*e*) Turn the pump shaft to insure freeness of rotation. If the shaft binds or is otherwise tight, disassemble and determine the reason. Correct and reassemble the pump.

(4) *Installation.*

(*a*) If the engine has been moved or rotated since removal of the oil pump, it is necessary to spot the engine with No. 1 cylinder in firing position. This may be noted from the position of the valves.

(*b*) Turn the oil pump drive gear so that the flat on the flange is to the outside of the pump (the side opposite the pressure relief valve).

(*c*) With the flat towards the camshaft, insert the oil pump into the cylinder block and rotate the oil pump to the correct position for attaching screws.

Note. The oil pump should not be rotated until after the drive gear is meshed with the gear of the camshaft.

(*d*) Install the oil pump mounting screws.

Note. If the fuel pump was not removed, care must be exercised that when the oil pump is installed the tongue of the fuel pump drive coupling properly engages in the groove in the oil pump drive gear, with the fuel pump in firing position for No. 1 cylinder. If the fuel pump was removed, a visual inspection of the oil pump drive gear groove will show that it is parallel with the engine when the gear is properly timed, with the crankshaft spotted in No. 1 cylinder firing position.

(*e*) Install the oil pan.

(*f*) Fill the crankcase to the proper level with the correct grade of lubricating oil.

(*g*) Install the overspeed switch drive.

l. Oil Seal.

(1) Wherever a shaft extends through the engine case and there is a possibility of oil leakage, an oil seal is used which also acts as a dust seal, preventing dust from entering the engine. At the flywheel end of the crankshaft the oil seal is mounted in the end plate so that it seals against the flange of the crankshaft.

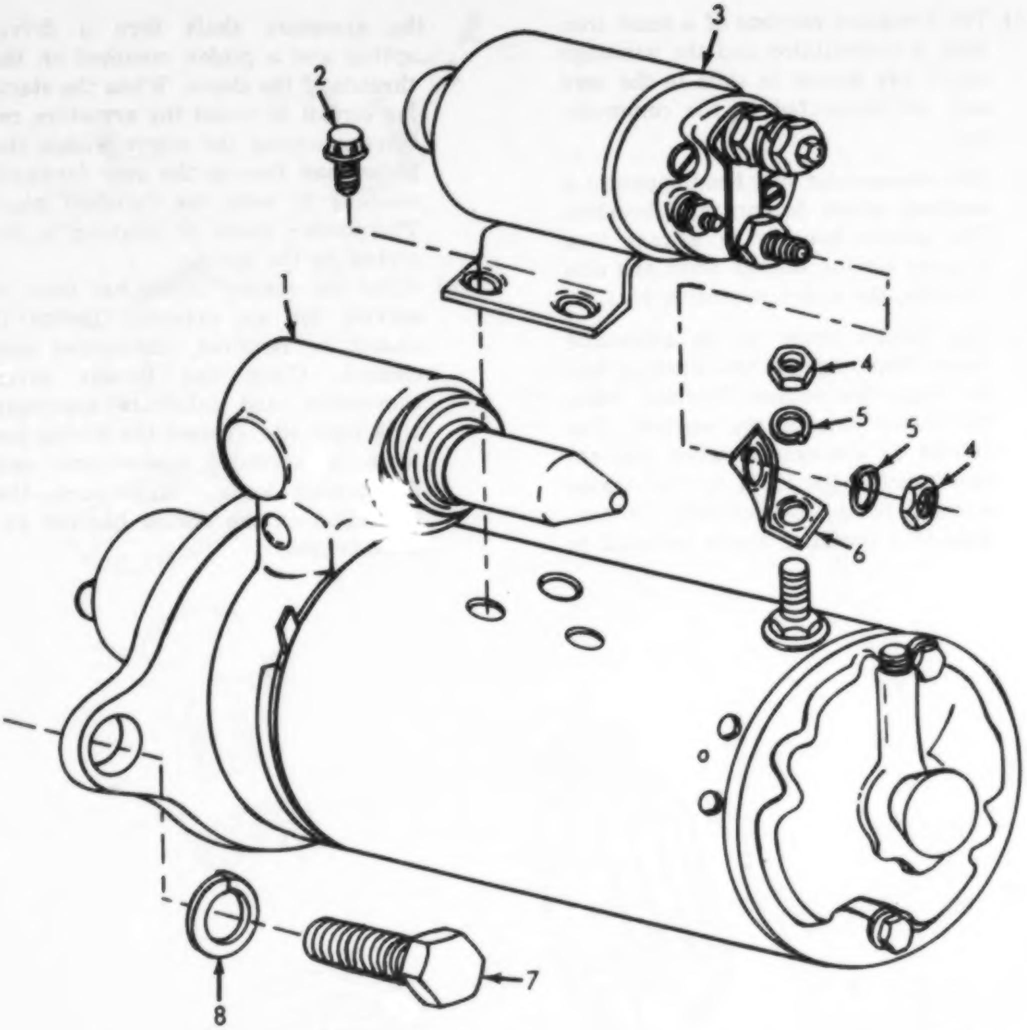
(2) At the timing gear end of the crankshaft the same type of seal is used against the gear cover. This type of seal requires very little attention; however, at assembly the shaft seal surfaces on which the seal rides must be thoroughly and carefully checked for nicks or scratches whch may have a tendency to damage the seal. If any nicks or scratches are found, they should be removed with an oil stone of very fine emery cloth and polished with Crocus cloth. If the shafts have a keyway which might damage the seal during installation, this keyway should be covered with a thin feeler gage to protect the seal.

(3) The shafts are tapered to allow the seals to easily slip into place. However, care is required in order not to damage the seals. A coating of oil soap on the seal surfaces of the shafts and, also, on the seals is helpful during the run-in period.

m. Starter Motor (figs. 30 *and* 31*).*

(1) The starter motor is designed to crank the engine when the switch closes the circuit between the storage battery and the motor. It consists of five main sub-assemblies: the frame and field, the armature, the commutator end head, the pinion housing and the Bendix drive.

(2) The frame and field consists of the frame which supports the components of the starting motor, the pole pieces and the field coils. The coils supply the path for the magnetic field.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1	Starter	5	Washer
2	Bolt	6	Contact
3	Relay	7	Screw
4	Nut	8	Washer

Figure 30. Starter motor.

(3) The armature consists of a small iron core, a commutator and the windings which are wound in slots in the core and are connected to the commutator.

(4) The commutator end head supports a bearing, brush holders and brushes. The pinion housing is a cast iron housing for the Bendix drive and also provides the motor mounting lugs.

(5) The Bendix drive is an automatic clutch that engages the starting motor with the engine flywheel when the motor cranks the engine. The starter is disengaged when the engine reaches 400 RPM by the starter solenoid being de-energized. It consists of a threaded sleeve fastened to the armature shaft thru a drive spring and a pinion mounted on the threads of the sleeve. When the starting circuit is closed the armature revolves, turning the sleeve within the pinion and forcing the gear forward, meshing it with the flywheel gear. The sudden shock of meshing is absorbed by the spring.

(6) After the starter motor has been in service for an extended period it should be removed, dismantled and cleaned. Clean the Bendix drive thoroughly and lubricate sparingly with light oil. Inspect the wiring for loose or corroded connections and for broken leads. Make sure the insulation on the wiring has not become frayed.

1 Washer
2 Washer
3 Bearing
4 Housing
5 Clutch assembly
6 Washer
7 Lever housing
8 Bearing
9 Washer
10 Bolt
11 Screw
12 Brush
13 Holder
14 Spring
15 Pin
16 Holder
17 Bolt
18 Washer
19 Frame
20 Bearing
21 Washer
22 Armature

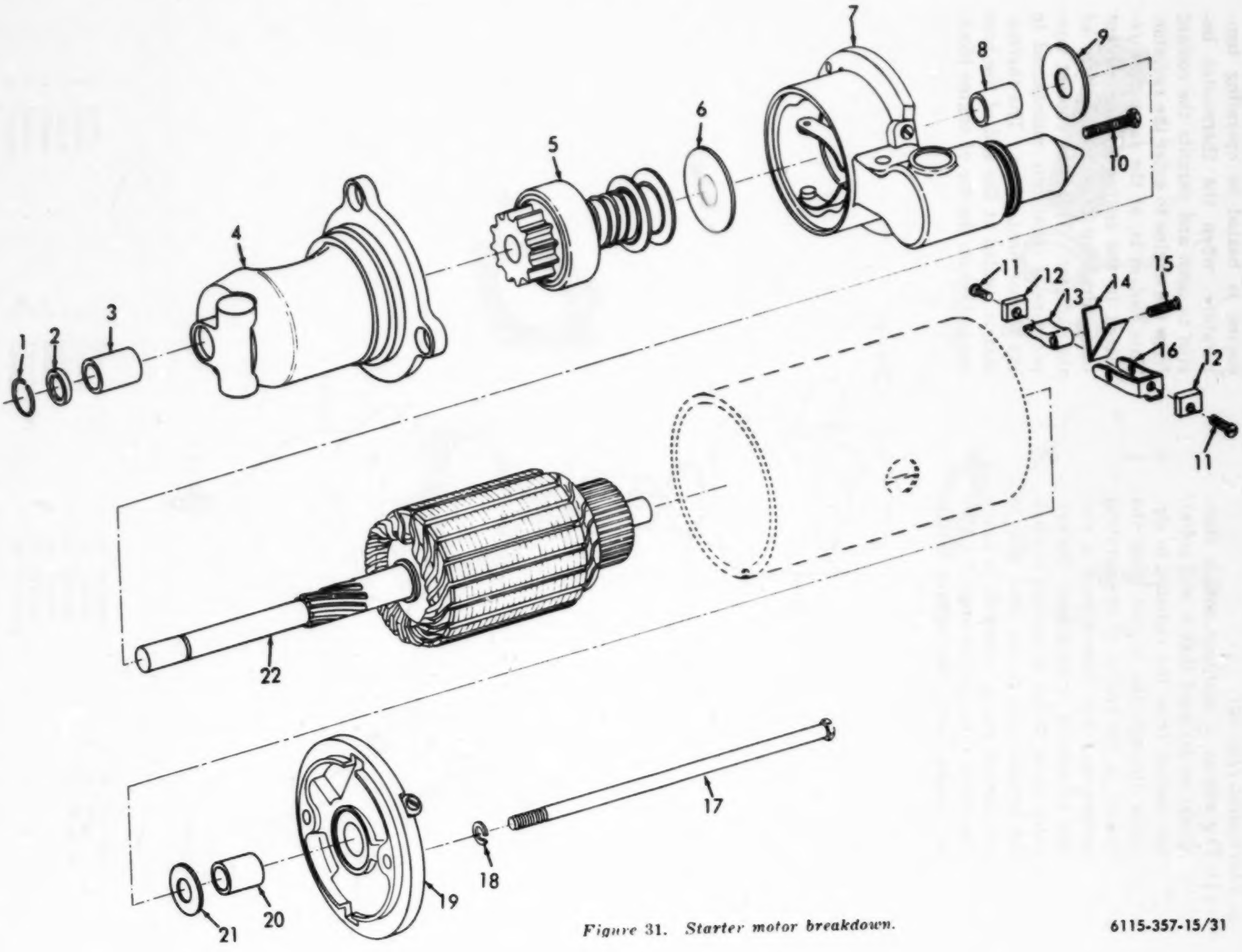
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Figure 31. Starter motor breakdown.

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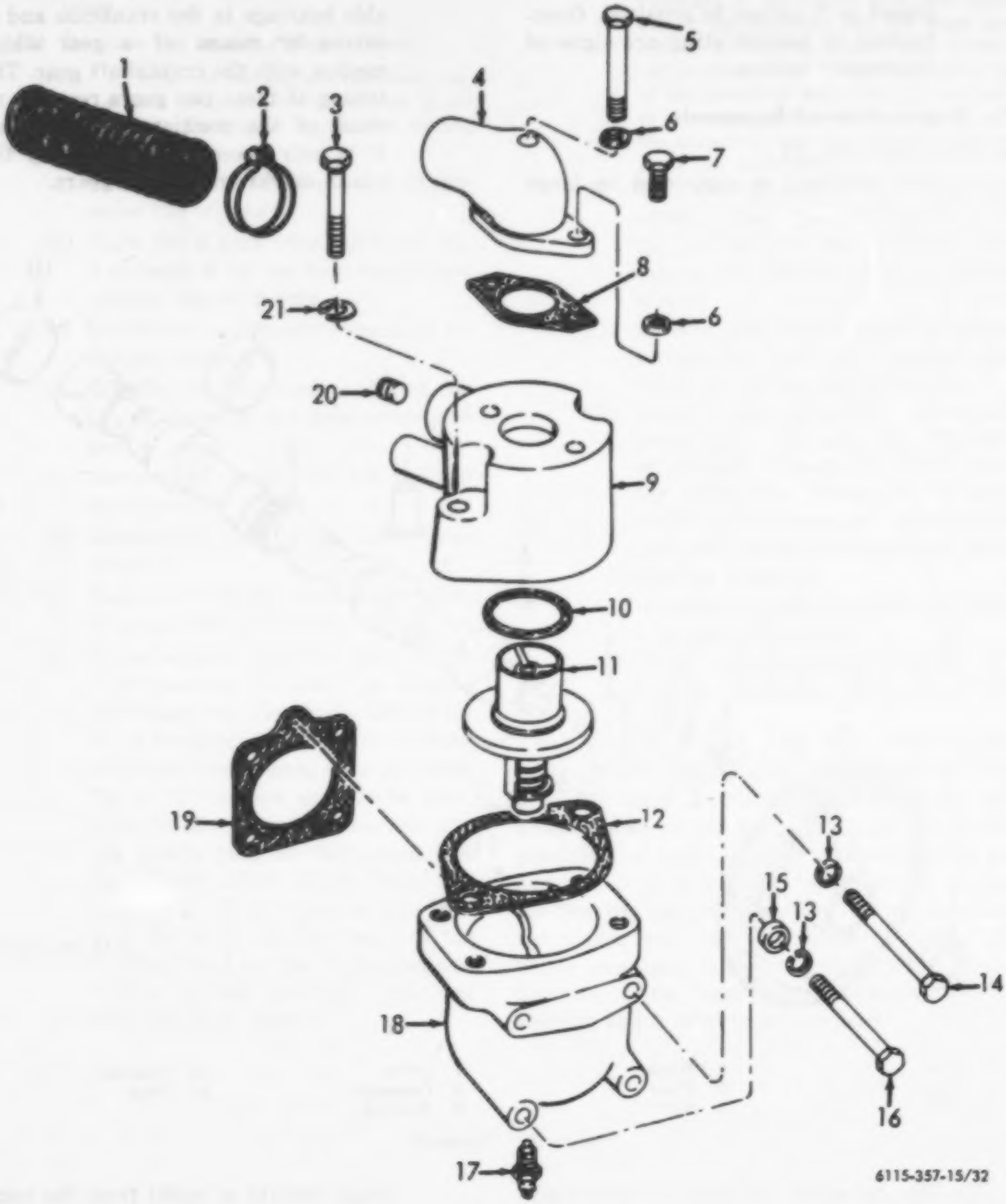
n. Thermostat (fig. 32).

(1) The engine is equipped with a thermostat so designed that it will not allow coolant from the radiator to circulate through the engine until the coolant in the engine is at operating temperature but does bypass a certain amount of coolant from the cylinder block, which is carried through the bypass tube to the inlet side of the coolant pump, where it is again circulated through the engine. This is repeated until the coolant in the engine is heated to operating temperature, when the thermostat begins to open and permits the coolant from the engine to enter the radiator. This coolant is, at the same time replaced in the engine by the coolant pump drawing from the bottom of the radiator. Thus, the coolant temperature is constantly maintained in the proper heat range. The thermostat is located at the end of the hose connection on the top of engine block.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1	Hose	7	Screw	13	Washer	19	Gasket
2	Clamp	8	Gasket	14	Screw	20	Plug
3	Screw	9	Housing	15	Spacer	21	Washer
4	Elbow	10	Seal	16	Screw		
5	Screw	11	Thermostat	17	Switch		
6	Washer	12	Gasket	18	Housing		

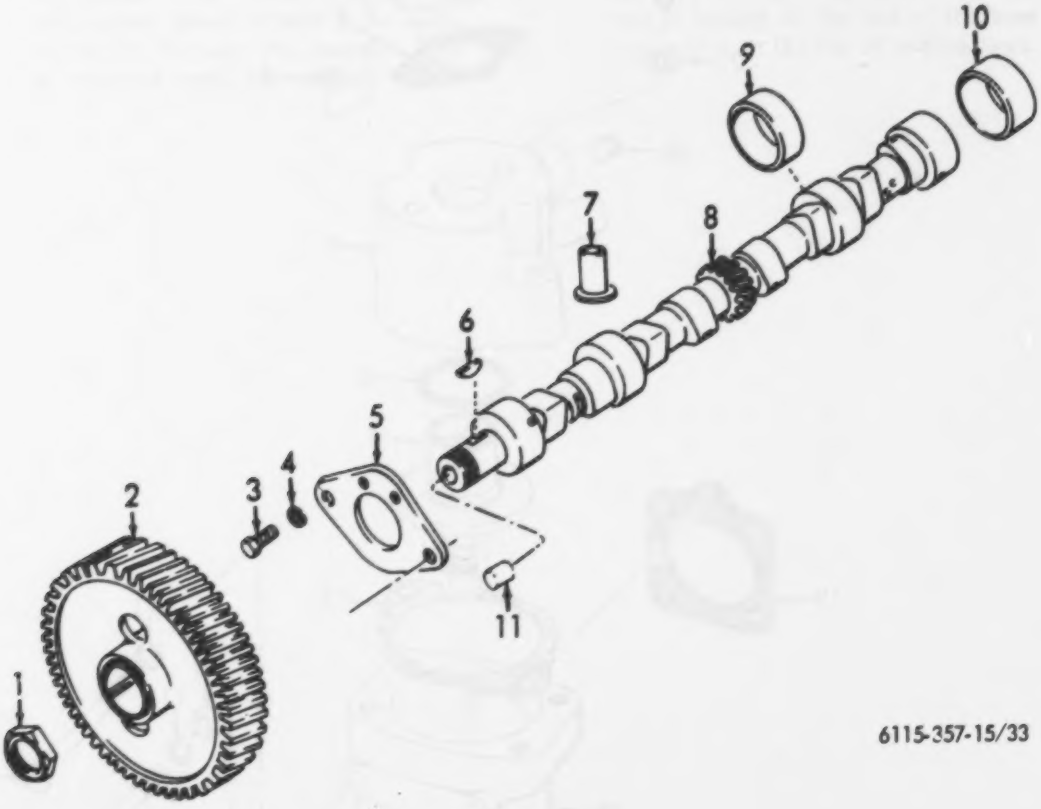
Figure 32. Thermostat and bypass.

(2) A defective thermostat must be replaced as it cannot be repaired. Overheating or underheating are signs of thermostat failure.

20. Engine Internal Exponents

a. Camshaft (fig. 33).

(1) The camshaft is supported on large diameter pressure lubricated removable bearings in the crankcase and is driven by means of a gear which meshes with the crankshaft gear. The timing of these two gears requires no check of the position of the valves. It is only necessary to line up the punch marks on the two gears.



6115-357-15/33

1 Nut
2 Gear
3 Bolt
4 Washer
5 Plate
6 Key
7 Lifter
8 Camshaft
9 Bearing
10 Bearing
11 Plug

Figure 33. Camshaft.

(2) The camshaft end play is controlled by a trust plate, located between the front camshaft bearing and the camshaft gear. Correct end play of .0015 to .0035 inch is regulated by the thickness of the thrust plate.

(3) To decrease the end play, it is permissible to remove by draw filing a small amount of metal from the camshaft gear hub on which the thrust plate rides.

(4) To increase the end play, it will be necessary to add a shim between the camshaft gear hub and the camshaft bearing or, using a piece of very fine emery cloth on a surface plate, polish

the thrust plate to the desired thickness.

(5) Remove the camshaft as follows:

Note. In order to remove the camshaft, the radiator, coolant pump and end plate must be removed. Refer to Sections of the manual dealing with each procedure.

(a) Drain the lubricating oil and remove the oil pan.

(b) Turn the engine over until the No. 1 cylinder is on top dead center and remove the oil pump.

(c) Disconnect and remove the fuel injection pump.

(d) Remove the fan blade and belt for easier access to the gear cover and gears.

(e) Remove the crank grab nut and fan drive pulley.

(f) Remove the gear cover. See "Gear Cover."

(g) Remove the rocker arm cover, rocker arms and push rods.

(h) Valve tappets must be held in the "up" position in order to remove and insert the camshaft. One method of accomplishing this is to make a holder from music wire by bending a "V" on one end of the wire. This holder may be inserted into the hollow part of the tappet and the tappet lifted away from the camshaft. This holder is then bent over the push rod hole edge of the cylinder head so that the tappet will remain in this position. Use one wire for each tappet.

Note. To remove and assemble the camshaft to the engine with the engine out of the generator set, the same procedure is followed, except step Number (*h*) is disregarded. With the engine out of the generator set, it is only necessary to set the engine on the end plate, push the tappets to the "up" position and remove the camshaft.

(i) With the tappets in the raised position, rotate the crankshaft until the two holes in the camshaft gear expose the thrust plate attaching screws.

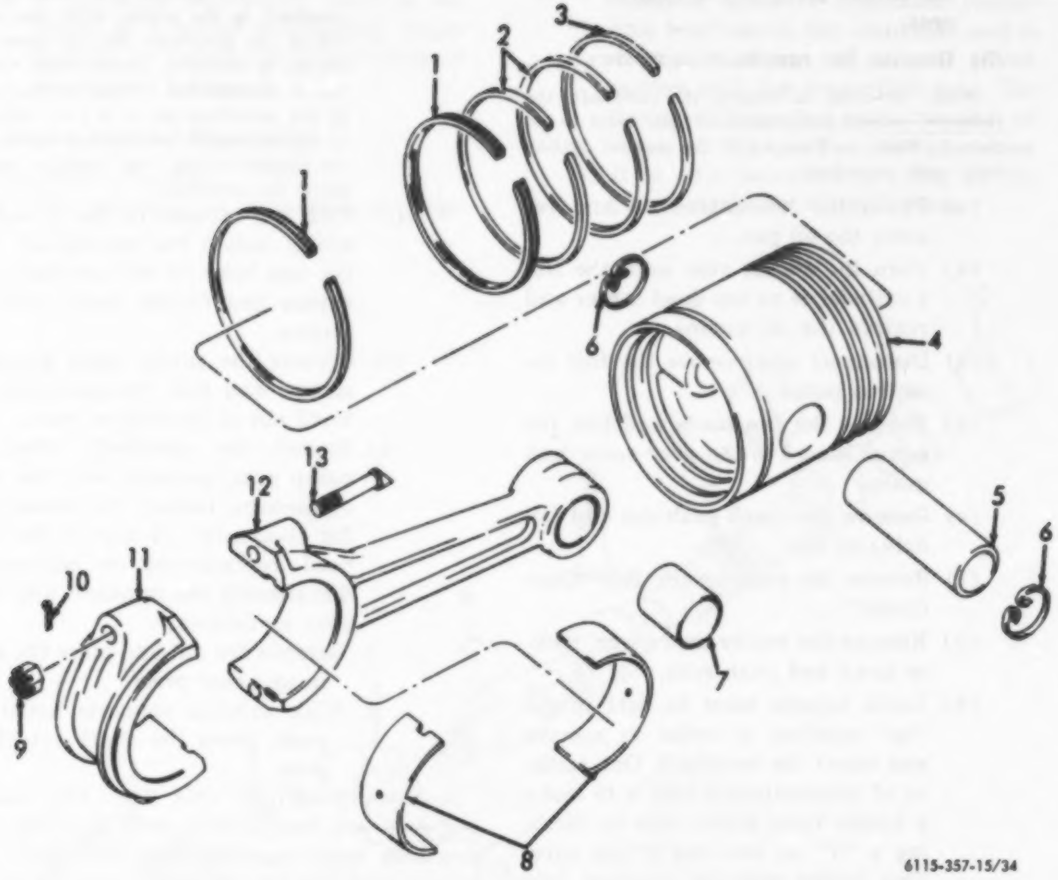
(j) Remove the thrust plate attaching screws and pull the camshaft forward out of the engine block.

(k) Inspect the camshaft lobes, oil pump gear, journals, etc., for wear or damage. Inspect the thrust plate for clearance. If any of the parts need replacement or adjustment, disassembly the camshaft and drive gear as follows:

1. Remove the nut and place the shaft in an arbor press.

2. With suitable supports under the gear, press the shaft out of the gear.

b. Connecting Rods (fig. 34). The connecting rods are heavy alloy steel forgings with precision type bearings for the shaft, and bronze bushings for the piston pins. With this precision or insert shell type bearing, the cap and rod is split slightly below center so that the bearing split opposite the locking lugs does not match with the split in the forging. No shims are used and, therefore, when reconditioning of the bearings is necessary, only the bearing shells need to be replaced.



1	Ring	5	Pin	9	Nut	13	Bolt
2	Ring	6	Ring	10	Cotter pin		
3	Ring	7	Bearing	11	Cap		
4	Piston	8	Bearing	12	Rod		

Figure 34. Piston and connecting rod.

Caution: **DO NOT FILE OR GRIND THE CAPS, AS NEW BEARINGS CANNOT BE INSTALLED IN A CONNECTING ROD THAT HAS BEEN FILED.**

Note. As built at the factory, the connecting rods and caps are marked on the camshaft side and to the front of the engine with the cylinder number in which they are used.

(1) *Removal of Connecting Rods.*

- *(a)* Drain the radiator and disconnect the hoses.
- *(b)* Remove the thermostat housing and thermostat so that the water pump bypass hose can be removed from the water pump. Also, disconnect the water temperature gage thermocouple.
- *(c)* Disconnect and remove the air cleaner from the manifold.
- *(d)* Disconnect the muffler from [illegible] manifold.
- *(e)* Disconnect the fuel lines and remove the pump (vertically mounted only) from the engine. See "Fuel Pump."
- *(f)* Remove the cylinder head cover, rocker arm assemblies and push rods.
- *(g)* Remove the cylinder head nuts and

lift the cylinder head assembly carefully from the engine (manifold may be removed with the head).

(*h*) Remove the oil pan and rotate the crankshaft so that Number 1 cylinder is in firing position and remove the oil pump. The overspeed switch drive must be removed before the oil pump can be removed.

(*i*) Carefully scrape the carbon deposit from the top of each cylinder bore so that the pistons can be removed without damage to the rings.

(*j*) Rotate the crankshaft so that Number 1 and Number 4 connecting rod caps can be removed and the piston and rod assembly pushed carefully upward with a block of wood or hammer handle to remove from the engine.

Note. Keep the rod caps and bearings of each respective rod together—do not mix.

(*k*) Rotate the crankshaft, as required, so that the other rods and pistons may be removed.

(2) *Disconnection of Connecting Rods from Pistons.*

(*a*) Remove the piston pin retaining rings and push the pin out of the piston and connecting rod bushing.

Note. The pistons may be heated in boiling water to facilitate removal of the piston pins.

(*b*) Inspect the piston pin and bushing for wear and replace, if necessary. If new parts are used, check the connecting rod alinement on a standard alining fixture.

(2) *Installation of Connecting Rods.*

(*a*) Assemble the connecting rod and piston and insert the retaining rings.

Note. To make it easier to assemble these parts, the piston may be heated in boiling water for a few minutes. Do not heat the piston pin.

(*b*) Inspect the crankshaft for any rough or scored marks that might damage the connecting rod bearing. If any rough marks are found, use an oil stone, very fine emery cloth or crocus cloth to polish the shaft. Clean the shaft thoroughly after polishing.

(*c*) Install the piston rings on the pistons.

(*d*) Select the proper piston and connecting rod assembly and turn the crankshaft so that it is in the correct position.

(*e*) Apply a liberal coat of lubricating oil to the cylinder bores, pistons, rings and piston pin.

(*f*) With the piston rings compressed, use a hammer handle or block of wood to force the piston and rings into the cylnder bore. At the same time, use care that the connecting rod is in line with the crankshaft journal.

(*g*) With the piston entirely in the cylinder bore, insert the upper bearing shell and pull the connecting rod down to the crankshaft.

(*h*) Place a ¼ × ½ × .003 inch piece of feeler stock in the cap. Place the lower shell in the cap and assemble the cap to the connecting rod. Tighten the cap screws to the proper tension and try the connecting rod for side movement. The connecting rod should move sideways with a firm pressure of the hand. After obtaining the proper movement of the rod in the above manner, remove the piece of feeler stock and reassemble the connecting rod cap. Tighten the screws, as before, and again try the side movement of the rod. It should move easily. Refer to "Fits and Tolerances", paragraph 24 for proper clearance and proper nut tension. If no torque wrench is available this tension would require a tight pull on a 12 inch wrench.

(*i*) Repeat the above operations for all connecting rods.

(*j*) Install the cotter pins, if used.

(*k*) Install the oil pump. Refer to "Oil Pump," paragraph 20, *e* below.

(l) Inspect the top of the cylinder block and pistons. Be sure no foreign matter is present and install the cylinder head gasket.

(m) Install the cylinder head. Refer to "Cylinder Head," paragraph *e* above.

(n) Insert the valve push rods and install the rocker arm assemblies.

(o) Adjust the tappets to the proper clearance. Refer to "Valves," paragraph 20, *h* below.

(p) Install the cylinder head cover, using a new gasket. Install the nuts and washers as removed.

(q) Install the thermostat, thermostat housing, water pump bypass hose and connect the water temperature gage thermocouple.

(r) Install the fuel injection pump, if removed, and fuel lines. Refer to "Fuel Injection Pump," paragraph 19*e*.

(s) Install and connect the air cleaner and connect the muffler to the manifold.

(t) Connect the radiator hoses and fill the radiator with proper coolant.

(u) Install the oil pan, using new gaskets, and fill the crankcase with the proper grade of lubricating oil.

Connecting Rod Bearing Replacement. If excessive clearance develops between the shaft and bearing shells, new bearing shells should be installed. If the clearance is excessive with the new bearings, regrind the shaft and use undersized bearings.

(3) *Connecting Rod Replacement.*

(a) Remove the oil pan. Refer to "Oil Pan," paragraph *i* below.

(b) Locate the crankshaft so the connecting rod cap can be removed.

(c) Remove the cotter pins, nuts and cap screws.

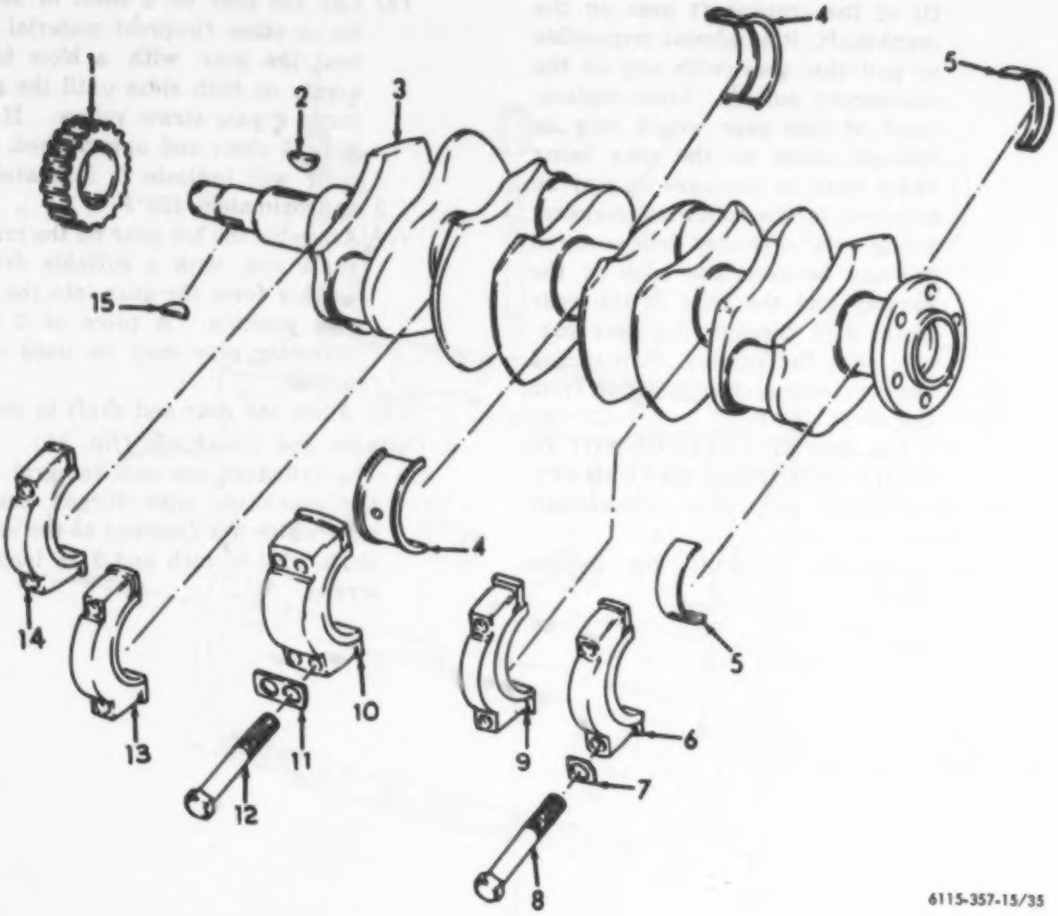
(d) With a soft hammer, tap the cap to loosen it and remove the cap.

(e) Replace the bearing shells.

(f) Reassemble the oil pan to the engine. Refer to "Oil Pan," paragraph 19, *i* above.

c. Crankshaft (fig. 35).

(1) The nominal diameter of the main bearings is 2⅞" while the nominal diameter of the connecting rod journals is 3⅜". The shaft has passages drilled to carry oil, under pressure, to the connecting rod bearings. These passages should be cleaned with a wire brush before the shaft is installed in the engine.



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1	Gear
2	Key
3	Crankshaft
4	Bearing
5	Bearing
6	Cap
7	Lockplate
8	Screw
9	Cap
10	Cap
11	Lockplate
12	Screw
13	Cap
14	Cap
15	Key

Figure 35. Crankshaft.

(2) While the diameters given above are only nominal, the following table gives the actual sizes, both standard and undersize, to which the shaft may be reground.

Caution: **WHEN REGRINDING A CRANKSHAFT, IT IS IMPERATIVE THAT THE ORIGINAL 5/32" RADIUS FROM JOURNAL TO CHEEK BE MAINTAINED. CRANKSHAFT BREAKAGE MAY RESULT FROM IMPROPER GRINDING OF THIS FILLET.**

HEAVY DUTY CRANKSHAFT

Size	*Main*	*Connecting rod*
Standard	2.8734/2.8744"	2.3730/2.3740"
.020" U. S.	2.8534/2.8544"	2.3530/2.3540"
.040" U. S.	2.8334/2.8344"	2.3330/2.3340"
.060" U S.	2.8134/2.8144"	2.3130/2.3140"

(3) *Removal of Crankshaft Gear.*

(*a*) If a suitable arbor press is not available, the following method may be used: Due to the extremely tight fit of the crankshaft gear on the crankshaft, it is almost impossible to pull this gear with any of the commercial pullers. Since replacement of this gear would only be brought about by the gear being badly worn or damaged, it may be removed in the following manner: Using a ¼" diameter drill centered midway between the edge of the keyway and the base of the gear teeth, drill through the gear parallel with the keyway, then spread the gear with a chisel and pull from the shaft.

Caution: **BE CAREFUL NOT TO DRILL INTO THE CRANKSHAFT.**

(4) *Installation of New Crankshaft Gear.*

(*a*) Insert the Woodruff key in the shaft.

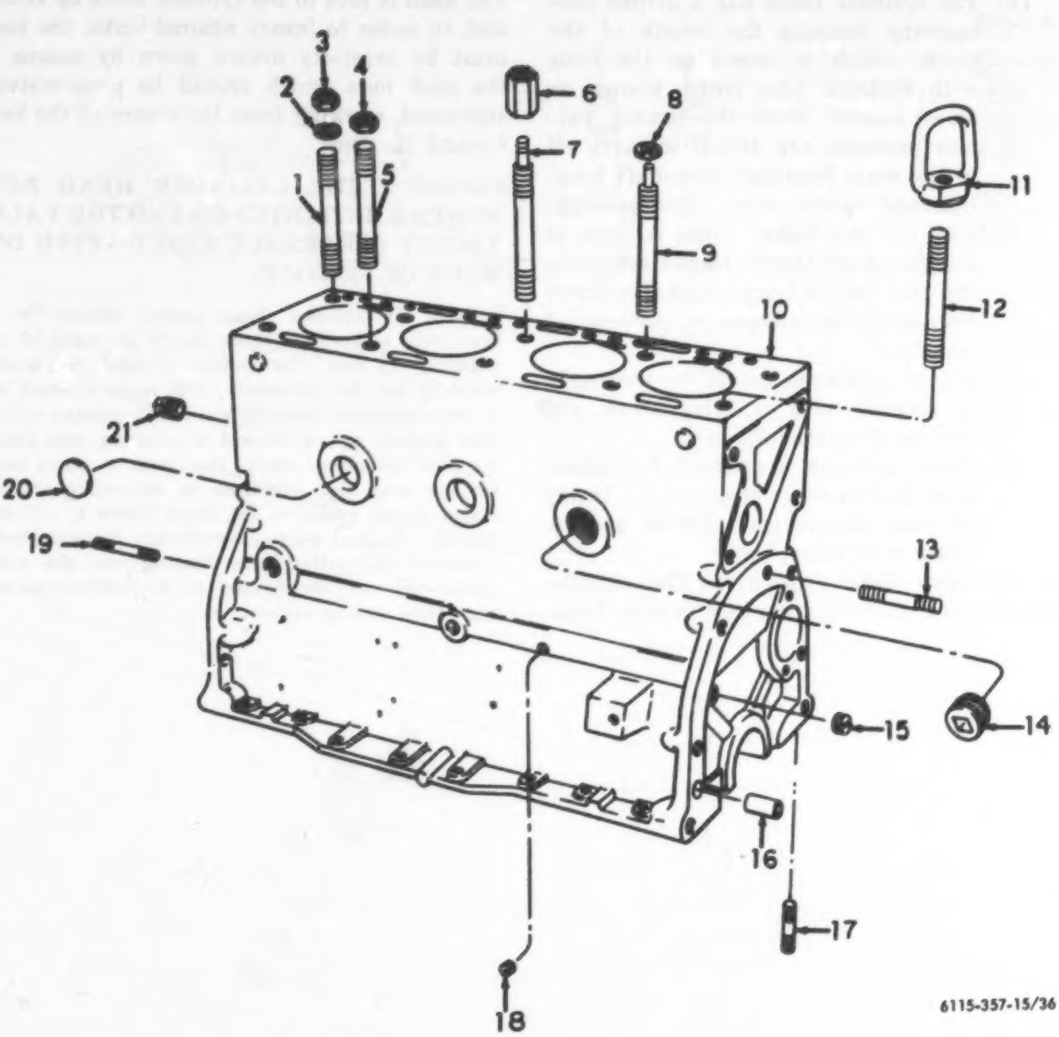
(*b*) Lay the gear on a sheet of asbestos or other fireproof material and heat the gear with a blow torch evenly on both sides until the gear turns a pale straw yellow. If the gear is clean and untarnished, this color will indicate it is heated to approximately 450°F.

(*c*) Assemble the hot gear on the crankshaft and, with a suitable driver, quickly force the gear into the correct position. A piece of 2 inch diameter pipe may be used as a driver.

(*d*) Allow the gear and shaft to cool.

d. Cylinder and Crankcase (fig. 36).

(1) The cylinders are cast integral with the crankcase with forged bearing caps which are fastened to the crankshaft with ½ inch and 9/16 inch cap screws.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1	Stud
2	Washer
3	Nut
4	Nut
5	Stud
6	Sleeve
7	Stud
8	Washer
9	Stud
10	Block
11	Nut
12	Stud
13	Stud
14	Plug
15	Plug
16	Plug
17	Pin
18	Plug
19	Pin
20	Plug
21	Plug

Figure 36. Engine block.

(2) The cylinder block has a drilled passageway running the length of the block, which is closed on the ends with suitable pipe plugs, known as an oil header. From this header, various passages are drilled to carry oil to the main bearings, camshaft bearings and rocker arms. The passageway for the rocker arms is open at the camshaft thrust flange screw on the rear of the blocks, and this screw hole must be plugged to prevent oil leakage.

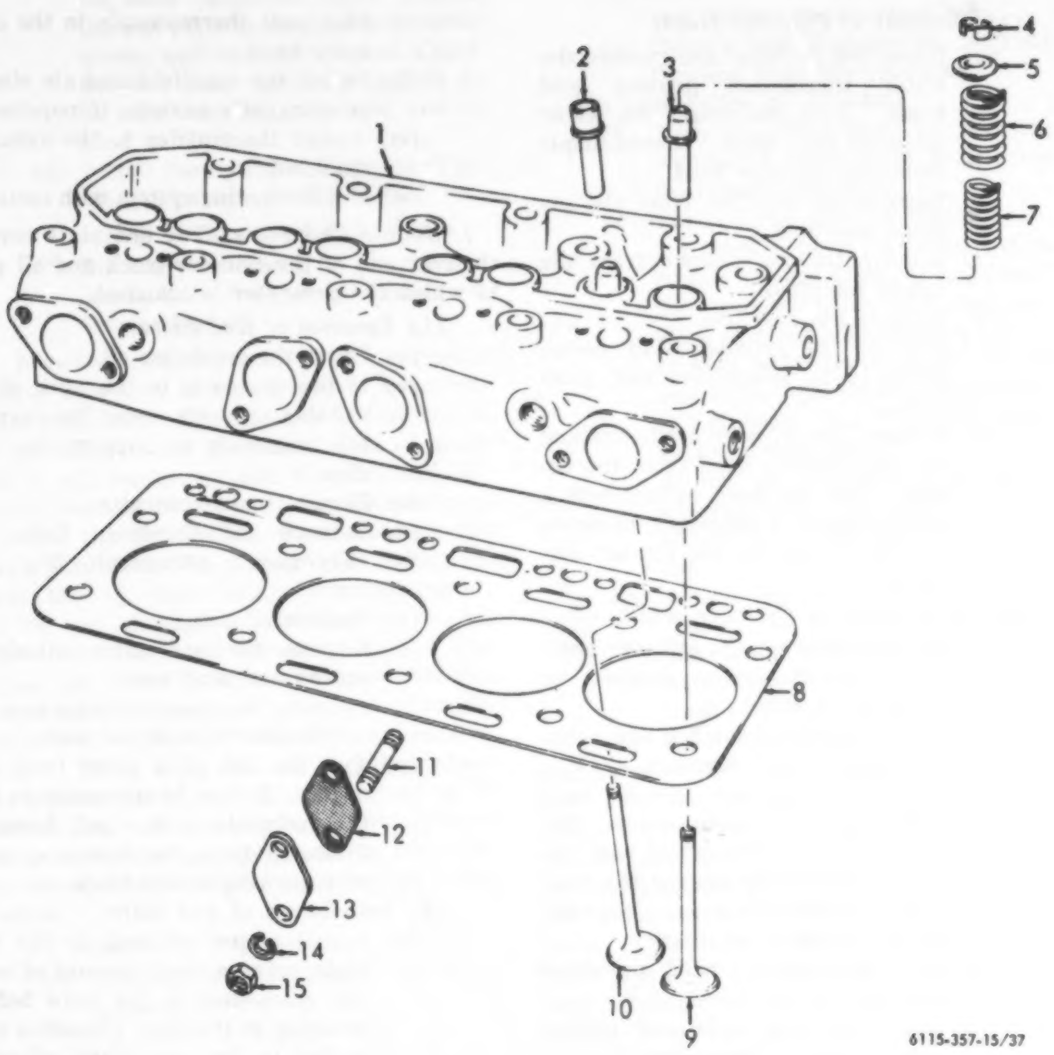
(3) All oil passages should be thoroughly cleaned with a wire brush and solvent at overhaul time.

(4) Core openings are closed by expansion type brass or steel plugs. If any of these should leak remove and replace with new plugs.

e. Cylinder Head (fig. 37). The cylinder head is a one piece casting and is detachable. The head is held to the cylinder block by studs; and, in order to insure against leaks, the head must be carefully drawn down by means of the stud nuts which should be progressively tightened, working from the center of the head toward the ends.

Caution: **THE CYLINDER HEAD NUTS MUST BE RETIGHTENED AND THE VALVE TAPPET CLEARANCE RESET AFTER ONE HOUR OF SERVICE.**

Note. If cylinder head gasket failure is encountered, a thorough check should be made of contributing factors. Detonation (caused by ignition which is too far advanced), will cause a shock load in the combustion chamber which will damage cylinder head gaskets and, if allowed to continue, may destroy the pins and piston rings. Fuel with a cetane rating too low may also contribute to detonation and corrosion of the gasket to the point where it will start leaking. Cooling solutions which are contaminated by corrosive combustion gases leaking into the cooling system are very detrimental to the internal parts of the entire cooling system.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1	**Head**	6	**Spring**	11	**Stud**
2	**Sleeve**	7	**Spring**	12	**Gasket**
3	**Guide**	8	**Gasket**	13	**Cover**
4	**Lock**	9	**Valve**	14	**Washer**
5	**Seat**	10	**Valve**	15	**Nut**

Figure 37. Cylinder head and valves.

(1) *Removal of Cylinder Head.*

(a) Drain the radiator and remove the water thermostat housing and hoses. Also, disconnect the water temperature gage thermocouple from the cylinder head.

(b) Remove the muffler from the exhaust manifold.

(c) Remove the air cleaner from the intake manifold.

(d) Remove the fuel line.

(e) Remove the cylinder head cover, rocker arm assemblies and push rods.

(f) Remove the cylinder head nuts and lift the cylinder head from the engine. Tap the head lightly with a soft hammer, if necessary, to loosen it. Do not pry on the contact surfaces.

(2) *Installation of Cylinder Head.*

(a) Before installing the cylinder head, clean out the carbon deposits by scraping or brushing.

(b) Clean the cylinder block and cylinder head contact surfaces.

(c) Install a clean, new cylinder head gasket on the cylinder block. The gasket must be assembled with the bead (rolled edge around the combustion chamber) down. No shellac or gasket is necessary.

(d) Place the cylinder head and valve assembly on the block.

(e) Start the head nuts and tighten evenly using a torque wrench. Start at the center of the head and work progressively to the outer ends. Refer to paragraph 24, Fits and Tolerances.

(f) Install the push rods and rocker arms.

(g) Adjust the valve tappets to the proper clearance.

(h) Install the cylinder head cover, using a new gasket, if required.

(i) Install the fuel lines.

(j) Inspect the thermostat. See "Thermostat."

(k) Install the thermostat, housing and hoses. Connect the water temperature gage thermocouple to the cylinder head.

(l) Install the manifold and air cleaner using new gaskets, if required.

(m) Install the muffler to the exhaust manifold.

(n) Fill the cooling system with coolant.

f. Engine End Plate. The end plate covers the rear end of the cylinder block ~~and oil~~ pan to which the generator is attached.

(1) *Removal of End Plate.*

(a) Drain the crankcase oil.

(b) If the engine is in the unit, place suitable supports under the rear of the crankcase to support the engine.

(c) Remove main generator.

(d) Remove the flywheel. Refer to "Flywheel," paragraph 20*g* below.

(e) Remove oil pan.

(f) Remove the end plate attaching screws and stud nuts.

Note. There are four bolts from the oil pan adapter to the end plate.

(g) Pull the end plate away from the engine. It may be necessary to tap the end plate with a soft hammer to loosen from the dowels or gaskets sticking to the block.

(2) *Installation of end plate.*

(a) Install a new oil seal in the end plate, using a small amount of sealing compound in the bore before pressing in the seal. Cement a new gasket to the end plate, allowing the cement to dry sufficiently to prevent the gasket from skidding.

(b) Clean and polish the oil seal surface of the crankshaft, making sure there are no nicks or scratches present. Crocus cloth or very fine polishing cloth is suitable for this purpose.

(c) Apply a thin coat of oil soap to the seal and the seal surface of the crankshaft. Be sure socket head screws are placed into proper hole positions. Using care in placing the oil seal over the crankshaft make sure that the dowels properly en-

ter their respective holes. Secure the end plate to the engine with the screws and nuts as removed. Check the end plate mounting dowels to be sure that they are tight and in good condition.

(d) Install the flywheel. Refer to "Flywheel," paragraph 20*g* below.

(e) Install the generator and oil pan.

(f) Fill the crankcase to the proper level with the correct grade of lubricating oil.

g. Flywheel. The flywheel on this engine is made of cast iron and machined to accommodate a generator. The flywheel is fastened to the crankshaft with six bolts. One of these bolts is off center so that the flywheel can only be installed in one position. This properly locates the flywheel on the crankshaft for timing purposes. The timing mark, which indicates that Number 1 piston is on top center, may be seen through a drilled hole provided in the end plate. All flywheels have a line marked DC (dead center) and from this line are graduations designating degrees of crankshaft travel. From DC these lines are marked 5°, 10°, 20°, 30°, and 40°. Intermediate lines between 10°, and 40°, are spaced at 2° intervals and are not marked. The flywheel is attached to the main generator by a flexible disc which is bolted to the outside edge of the flywheel.

(1) *Removal of Flywheel.*

(a) Disconnect and remove the main generator.

(b) Remove the flywheel bolt lock wire and remove the flywheel bolts.

(c) Using a Lady-Foot pry bar, pull the flywheel from the crankshaft.

(2) *Installation of Flywheel.*

(a) Turn the crankshaft so that the Number 1 cylinder is in the top dead center position.

(b) Turn the flywheel so that the timing mark is in line with the timing hole in the end plate. Then, install the flywheel on the crankshaft and draw in place with the flywheel attaching bolts. Do not draw any one bolt tight until all are progressively tightened. See "Fits and Tolerances," paragraph 24.

(c) Attach the indicator to check the concentricity of the pilot bore. This should not exceed .005" total reading.

(d) Attach the indicator to check the face of the flywheel. This should not exceed .005" total reading.

(e) Install the lock wires.

(f) Install the starting motor.

h. Gear Cover and Housing (fig. 38). The gear cover consists of the cover and gear housing. The gear housing also forms the front support for the engine and is doweled to the cylinder block. The cover plate covers the gear housing and gears. The front oil seal for the crankshaft is also installed in the cover plate. This cover plate can be removed for inspection of the gears without removing the gear housing.

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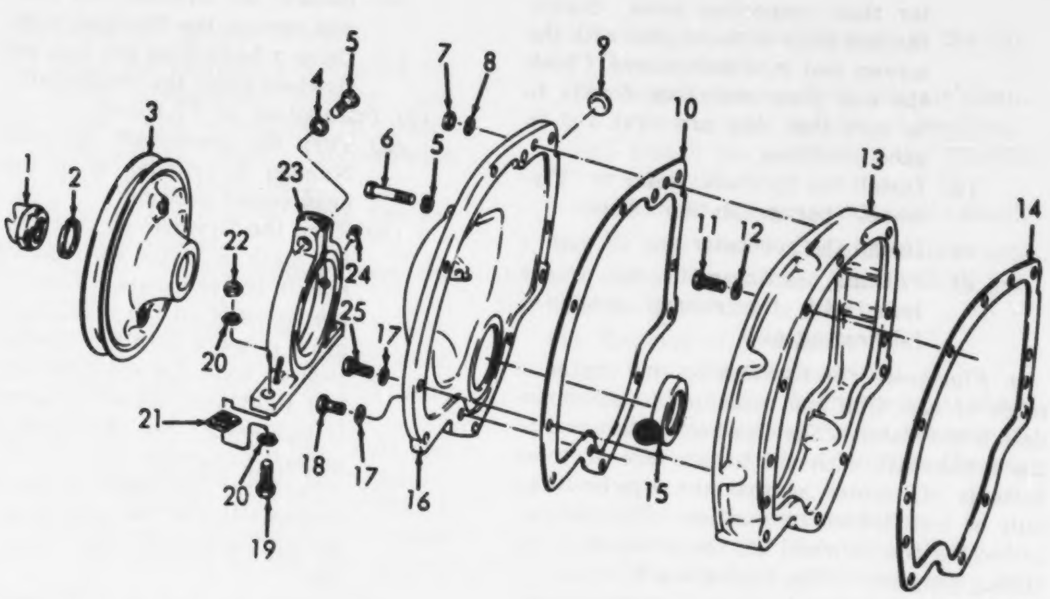

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1	Nut
2	Washer
3	Pulley
4	Washer
5	Screw
6	Screw
7	Nut
8	Washer
9	Plug
10	Gasket
11	Bolt
12	Washer
13	Housing
14	Gasket
15	Seal
16	Cover
17	Washer
18	Screw
19	Screw
20	Washer
21	Mount
22	Nut
23	Support
24	Plug
25	Screw

Figure 38. Gear cover.

(1) Removal of Gear Cover. The radiator must be removed from the mounting frame.

(a) Remove the fan blade and belt for easier access to the gear cover and gears.

(b) Remove the crank grab nut and fan drive pulley.

(c) Remove the screws from the gear cover and pull the gear cover forward away from the engine.

(d) If necessary to remove the gear housing, remove the camshaft as outlined under "Camshaft," paragraph *a* above. Remove the housing attaching screws and pull the housing forward away from the cylinder block.

Note. It may be necessary to tap the housing with a soft hammer to loosen it from the dowels or gasket cement. There are four bolts from the oil pan adapter to the gear housing. It is necessary to remove the oil pan to remove these.

(2) Inspection of Gear Cover and Housing. The gear cover and housing should be carefully inspected for possible cracks, binding, etc. Be sure that the camshaft gear retaining nut is tight. Replace any worn or damaged parts.

i. Main Bearings (fig. 35).

(1) The use of five main bearings in the four cylinder engine permits a main bearing to be placed on each side of each connecting rod bearing. The center main bearing cap is held in position by four alloy steel cap screws ½ inch in diameter while the remaining ones are held in position by two alloy steel cap screws 9/16 inch in diameter.

(2) The main bearings are removable

shell type and the upper shell is not interchangeable with the lower shell for each bearing. No shims are used. Reconditioning of this type bearing is accomplished by replacing the shells. These shells are completely finished before being put in place and no line reaming or scraping is required. This allows renewal of bearings to be easily accomplished. Each shells has a small ear or projection which fits into a recess and allows the ear to rest against the adjoining case or cap to prevent the shell from rocking or rotating.

(3) *Fitting of the Bearings.*

(a) The bearings in these engines are readily accessible after the oil pan and oil pump are removed. The bearings should never be fitted so tight that they bind or drag, see "Fits and Tolerances," paragraph 24. A certain minimum clearance is required at all times to provide an adequate oil film between the shaft and bearing and insure a free running engine.

(b) Tightening of the main bearing cap screws requires some care to prevent too much strain on the parts. No attempt should be made to refit these bearings by filing or grinding the caps, as this will ruin the caps so new shells cannot be installed.

(4) *Replacement of Main Bearings.* It is not necessary to remove the engine from the generator set to replace the main bearings unless the crankshaft is so damaged or worn it must be replaced. The following outline may be used as a guide for replacing the bearings when the engine has not been removed from the generator set.

(a) Disconnect the battery cable at the battery as a safety measure.

(b) If the starter is mounted below the oil pan level and causes interference, disconnect the starter cable and wiring; then remove the starter.

(c) Drain the crankcase oil.

(d) Remove the oil pan.

(e) Remove the oil pump.

(f) Remove front and rear oil pan adapters.

(g) Loosen all main bearing cap screws.

(h) Remove one bearing cap at a time and make bearing replacement. To remove the upper shell, a small pin may be inserted in the crankshaft oil hole and the shaft rotated so that the pin will push the bearing out. The new bearing may be inserted in the same manner.

Caution: **BE SURE TO REMOVE THE PIN BEFORE ASSEMBLING THE BEARING CAP.**

(i) Assemble the bearing cap and lower shell and tighten the screws. If no torque wrench is available, use a wrench with a 12 inch handle.

(j) After installing new thrust bearings on the center main bearing, check the end thrust. Refer to "Fits and Tolerances," paragraph 24. It is permissible to draw file the thrust bearings to obtain the proper clearance, if necessary.

(k) Thoroughly recheck the inside of the engine for loose screws, nuts, and associated parts.

(l) Install front and rear oil pan adapters.

(m) Install the oil pan.

(n) Install the starter.

(o) Connect the starter cables.

(p) Connect the battery cable.

(q) Fill the crankcase to the "FULL" mark on the dip stick with the proper grade of oil.

(r) Start the engine and immediately check the oil pressure. If sufficient, allow the engine to run for a few minutes while checking for oil leaks. Stop the engine and recheck the oil level. Add oil, if necessary.

j. Manifold (Intake and Exhaust) (figs. 2 and 3).

(1) *Removal.*

(a) Remove the air cleaner or air clean-

er connections from the intake manifold.

(b) Remove the muffler from the exhaust manifold.

(c) Remove the manifold attaching nuts and washers and remove the manifold.

(2) *Installation.*

(a) Use new gaskets and making sure all gasket surfaces are clean, place the manifold gaskets on the attaching studs and assemble the manifolds to the engine with the nuts and washers as removed.

(b) Tighten the manifold into place. Tighten all nuts lightly; then starting from the center, work progressively toward the ends of the manifold, repeating until all nuts are tight.

(c) Install the muffler.

(d) Install the air cleaner or connect the air inlet tube to the intake manifold.

(e) After the engine has been operated a day or more, tighten all manifold attaching nuts.

k. Piston (fig. 34).

(1) The piston is of the solid type, having no saw slots or split in the skirt. Five piston rings are used — the upper three rings are of the compression type while the fourth ring from the top, which is above the piston pin, and likewise, the ring located near the bottom of the skirt are of the oil regulating type.

(2) The pistons should be fitted to the cylinder bores with the proper clearance. ("Fits and Tolerances," para. 24.) If a feeler ribbon is used, this should be a ribbon ½ inch wide and of the thickness indicated in the Clearance Table. A scale should be used to obtain the pull indicated in the Clearance Table.

(3) To remove or install pistons, refer to "Connecting Rods," paragraph *b* above.

l. Piston Pin (fig. 34). The piston pin is a large diameter pin of the full floating type. This means that the pin can rotate in either the piston bosses or in the bushing at the top end of the connecting rod. But, the fit in the piston is intended to be much tighter than the fit in the connecting rod; consequently, the movement in the piston consists of a light, creeping action while the normal rotation of the pin occurs in the bushing at the top end of the connecting rod. The piston is prevented from moving endwise and making contact with the cylinder wall by means of snap rings, which locate in grooves machined in the bosses of the piston. Piston pins should fit in the piston bosses with the proper clearance, as indicated in the "Fits and Tolerances" paragraph 24.

m. Piston Rings (fig. 34).

(1) The piston rings, when fitted in the cylinder bore of the engine, should have a gap clearance between .015 inch and .020 inch. The piston ring land clearance is indicated in the "Fits and Tolerance" paragraph 24.

(2) When installing new piston rings, each ring should be tried in the cylinder bore to see if it has the correct gap of .015 inch to .020 inch. If necessary to increase the gap, the ring should be held and filed in a vise. The vise jaws must be covered with some soft metal. The ends of the rings are squeezed together and the file cuts on both sides. This will insure the ends being parallel. When inserting the ring in the cylinder bore to test the gap clearance, push the ring part way through the bore, using the bottom of a piston to square the ring in the bore.

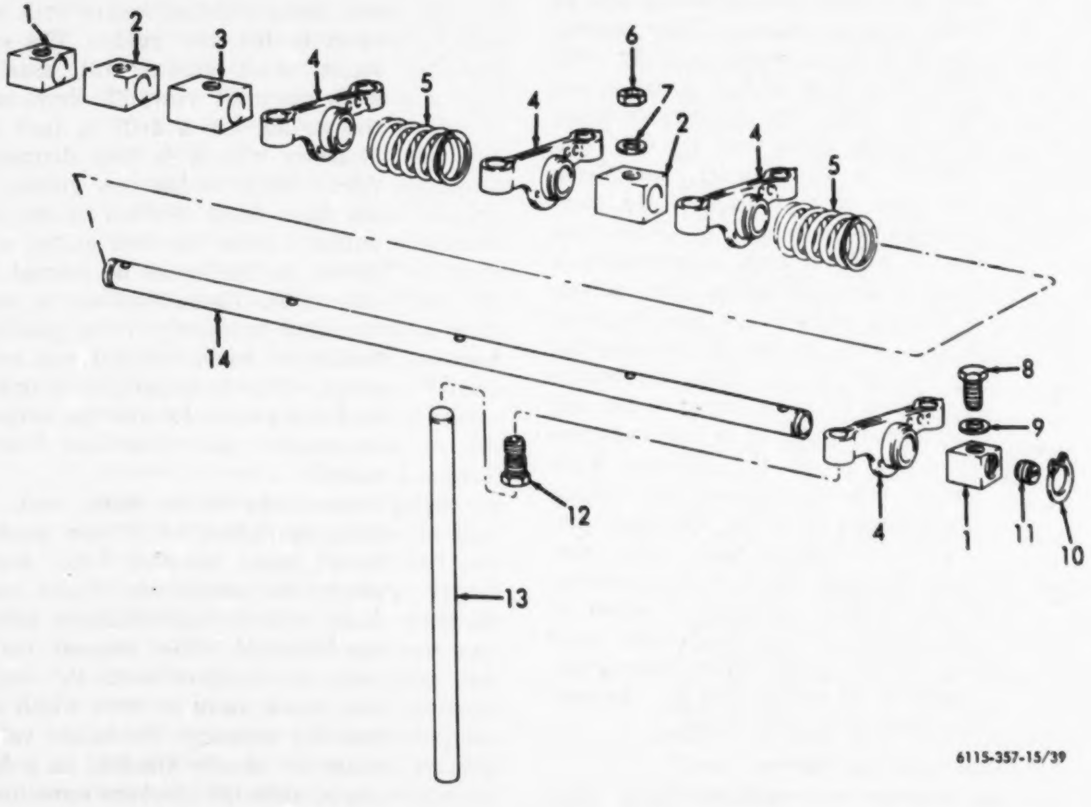
(3) Each new ring should be tried for clearance in the piston groove by rolling the ring all the way around the groove. If the piston grooves have been carefully cleaned, the rings will be found to fit correctly; but, if they are tight, they can be lapped slightly on a sheet of emery cloth (Number 000) laid on a flat surface. Use a light uniform pressure when lapping.

(4) When assembling the piston rings to

the piston, if a ring spreader tool is not available, the rings can be slipped over thin strips of metal. Whatever method is used, the rings must be handled carefully in order not to distort or break them.

n. Valves (figs. 37 and 39).

(1) The intake and exhaust valves operate in valve guides pressed into the cylinder head. They are held to their seats by strong steel springs, which are fastened to the valves by suitable spring seats and a valve lock arrangement. The valves, being located in the cylinder head, are operated by conventional type tappets with hollow push rods running from the tappets to the rocker arms. The rocker arms are lubricated by means of oil forced through a hollow cylinder head stud into the shaft on which they rotate. Oil is forced out, through small holes in the rocker arms, over the valve stems and push rods. The replacement of valves and valve guides will be found under "Valves Grinding" below. The replacement of valve tappets will be found under "Valve Tappets" also following.



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1 Support
2 Support
3 Support
4 Arm
5 Spring
6 Nut
7 Washer

8 Screw
9 Washer
10 Ring
11 Plug
12 Screw
13 Rod assembly
14 Shaft

Figure 39. Rocker Arm and Shaft.

(2) The natural vibrations of the valve train and the flow of gases around the valve head cause the valve to rotate slowly, a small faction of a revolution each lift cycle.

(3) In order to continue to get good performance from an engine, it may be necessary to grind or reseat the valves at varying intervals. The frequency for doing this depends on the care in the operation of the engine. If the air cleaners have been properly cared for; if the lubricating oil has been properly maintained; and if the clearance between the valve stem and rocker arms has been properly adjusted, valve grinding will be held to a minimum. Their seating should be tested periodically by rocking the engine against compression; that is, using the handcrank bring each piston up in turn for full compression in the cylinder, the piston will slide or rock back if the compression is satisfactory. When the engine will not rock, compression is leaking through either the valves, cylinder head gasket or past the piston rings. Check the leak by listening for a "hissing" sound, when the engine is cranked by hand, either at the cylinder head gasket or in the crankcase breather. If at the cylinder head gasket, remove the head and replace the gasket. If in the breather, dismantle the engine and install new parts for those found worn or scored. If no "hissing" is heard at either of these places, remove the cylinder head and valves. Clean both thoroughly, removing all carbon and oil. Inspect the valve seats and valves.

(4) *Removal of Valves.*

(a) Remove the cylinder head. See "Cylinder Head."

(b) With a clamp type valve spring compressor, compress the valve springs and remove the valve seat locks.

(c) Remove the valve springs and seats and lift out the valves. Place the valves in a cardboard or wood block, drilled and numbered so that the valves may be reinstalled in their respective places when reassembling (do not mark the valves with a file or punch).

(d) Clean all carbon from the cylinder head, piston heads, valve seats, valve guides and valves with suitable scraping or buffing tools.

(5) *Valve Grinding.*

(a) Inspect the valve guides for excessive wear. If the valve guides are to be removed, this should be done before any work is done on the valve seats. This will insure the seat being finished square with respect to the new guide. The exhaust valve guides will usually show the most wear. To drive out the guides, use a drift ⅝ inch in diameter with a ⅜ inch diameter pilot. Drive in the new guides to the same depth location as the old guides. After the new guides are driven in, they must be reamed to size on the inside diameter to correct any squeezing in or possible distortion due to being driven into place. This is important in order to get a proper fit and the proper clearance. See "Fits and Tolerances."

(b) Inspect the valve seats; and, if they are pitted or if new guides have been installed, the seats should be refinished. Valve seat tools with ⅜ inch diameter pilots are required. The exhaust valve seats are finished on a 45° angle and should have an even width all the way around. The intake valve seats are usually finished on a 45° angle, although they are sometimes less. Reseat the seats with a vibrating angle grinder type reseating tool. Because of the large diameter and surface of the valve seats, it is very difficult to obtain a good reseating job with a reamer type tool. Remove all shoulders

and pits from the seat but do not grind any deeper than necessary. Then finish the new or refaced valve to the reseated seat by hand in the usual manner.

(c) Inspect the valves carefully; if the stems are badly worn, bent, or deeply pitted replace with new ones. However, valves that are only slightly pitted can be used by refacing them on a valve grinder. Valves must have an accurately finished face of the correct angle. See "Fits and Tolerances" for the seat face width.

(d) If the valves and seats are not deeply pitted or shouldered or have been refaced, grind or lap each valve to its seat. Obtain a light coil spring with enough tension to just hold the valve off the seat. Lubricate the valve stem and apply a thin coating of good quality, medium coarse grinding compound on the valve face. Insert the valve in the valve guide and rotate the valve back and forth, about a quarter of a turn, a few times, pressing firmly on the grinding tool. (Avoid continuous round and round motion that would cut grooves in the valves or seat.) Release the pressure on the tool and the spring should lift the valve from its seat. Rotate the valve 15° or 20° and repeat the grinding process. It will probably be necessary to wipe off and inspect the valve and seat during this process to see what progress is being made; also, the compound may wear off the surface being ground. In either case, reapply another thin coating of compound and continue grinding until inspection shows the surfaces are in contact. Then wipe off all heavy compound and apply a thin coating of "fine" compound and continue the grinding. When the surfaces are "finished" and show a bright, silver-like band of uniform width on both the valve and seat, cle off all traces of the compound. T each valve for a tight fit by ma ing ten or twelve pencil mark equally spaced, across the val seat and firmly rotate the valve the seat for a part of a turn a again lift out the valve and o serve if all the pencil marks a rubbed out on the contact surfac If not, regrind until this test show a gas tight mating of the valv and seat.

Note. It is imperative that the valv be assembled in the same seats to whic they were ground.

(6) *Reassembly of Valves.*

(a) Thoroughly clean all traces of th grinding compound off the valves stems and guides; put a few drops of oil on the valve stems and insert the valves.

(b) Using a valve spring compressor compress the valve springs and insert the valve locks.

(c) Turn the head on the exhaust manifold side and pour gasoline in the intake openings. If gasoline seeps out around any valve, remove that valve and regrind. Repeat the test, pouring gasoline in the exhaust openings. If any exhaust valves leak, regrind.

(d) Install the cylinder head and valves on the engine.

(e) Adjust the valve tappets to the approximate setting. See "Fits and Tolerances." This is accomplished by the spotting of the crankcase and rocker arms to follow the engine fire order of 1, 2, 4, 3 starting from the timing gear end. The valve tappet screws are self-locking, and therefore, no lock nut is used. Use the following procedure:

1. Crank the engine over until the intake valve of Number 1 cylinder just starts to open. Then adjust the tappets on Number 4 cylinder.

2. Crank the engine over until the

exhaust valve of Number 2 cylinder just closes and the intake valve of Number 2 cylinder just starts to open. Adjust the tappets on Number 3 cylinder.

3. Crank the engine over until the valves of Number 4 cylinder are in the position noted above and adjust the tappets on Number 1 cylinder.

4. Crank the engine over until the valves on Number 3 cylinder are in a position noted above and adjust the tappets on Number 2 cylinder.

(f) The above completes the valve tappet adjustment until after the engine is started and warmed up to operating temperatures, at which time the valve tappets should be readjusted to the correct hot operating clearance.

Caution: **THE CYLINDER HEAD NUTS MUST BE RETIGHTENED AND THE VALVE TAPPETS RESET AFTER ONE HOUR OF SERVICE.**

(g) Install the cylinder head cover and any other parts that have been removed.

(h) Fill the cooling system with coolant. Start the engine and warm up to operating temperatures.

(i) Readjust the tappets to the correct operating clearance.

o. Valve Tappets. The valve tappet is of the mushroom type and is hollow to receive the push rods.

(1) *Disassembly of Valve Tappets.*

(a) Remove the camshaft. Refer to "Camshaft," paragraph 20, *a* above.

(b) Remove the tappets from the cylinder block.

(c) Check the tappets for wear and replace any that have excessive clearance.

(2) *Installation of the Valve Tappets.*

(a) Check each tappet in the cylinder block position to see that it has the correct clearance (para 24.) and install the tappets.

(b) Reassemble the camshaft. Refer to "Camshaft," paragraph 20, *a* above.

(c) Adjust the valves. Refer to "Valve Grinding," paragraph 20, *n* above.

21. Main Generator (figures 4 and 5).

The main generator assembly is a synchronous type designed for coupling to a diesel driven engine by a flexible coupling disc.

The rotor features "unicore" construction and is supported at one end by a single bearing, mounted in a bearing support and held in place by a retainer bracket bolted through the stator frame. The opposite end of the rotor is provided with a blower assembly and a flexible coupling disc which bolts directly to the engine flywheel and supports that end of the rotor.

The transformer-coupled voltage regulator assembly is mounted on the component tray. The static exciter mounted adjacent to the voltage regulator on the component tray, consists basically of 3 DC controlled current voltage transformers (CVT), three reactors and a full-wave rectifier assembly.

a. Mounting. Check mounting of generator periodically to see that it is secure.

b. Output Current and Voltage. Check the output current and voltage with external meters. If current or voltage is not proper, inspect brushes for signs of wear, proper spring pressure and freedom of action in the holder. Examine brush holders and clean when necessary.

c. Slip Rings. Surface condition of slip rings should appear smooth and clean. Scored, rough or blackened surfaces may be caused by grit or abrasive in brushes, accumulations of dirt around unit and oil or grease. Use a dry lint-free textured cloth to remove grease accumulations. Moderately rough or scored surfaces can be smoothed by using a fine sandpaper (Number 00). Do not use conductive abrasives.) Blow out dirt and grit with clean compressed air.

d. Brush Springs. A negator type spring is used, which has a rated pressure of approximately 5-6 lbs./sq. inch. The spring pressure should present no problem. Check springs for even set against brush and fit in slot. See that rivet securing spring to its bracket is secure.

e. Brushes. Check brushes for cracks, chips and uneven wear. The collector ring brush has: a total effective length of ¾ inch from lower edge of brush level at lead end to center of arc; a minimum limit of ⅜ inch from lower edge of brush level at lead end to center of arc. The slip ring brush has: a total effective length of 11/16 inch from lower edge of brush bevel at lead end to top of bevel at face; a minimum limit of ⅜ inch from lower edge of brush bevel at lead end to top bevel at face. Replace brushes that are worn to the minimum limits or to a point where the lead is exposed on the brush face.

When replacing brushes, it is important that they are carefully fitted to the contact surface. To fit brushes, slip a piece of grade Number 00 flint paper between contact surface with flint surface facing the brush, being sure that the paper is the same width as the contact surface. Move the paper in one direction only, lift and return until a minimum of 75 percent of the brush surface contacts the ring.

Repeat process until all brushes have been seated. New brushes that have not been seated may spark. If sparking occurs, operate the generator set at a light load to wear brushes. Sparking should diminish as brush acquires full surface contact.

f. Main Generator Removal (Fig. 3). The main generator must be removed from the set before disassembly. Remove the main generator as follows:

Note. To keep the engine balanced during this procedure hold up the rear of the engine with the rear engine support.

(1) Remove the top and side covers of the generator housing.
(2) Remove the static exciter, voltage regulator current transformers, and control panel — the components tray
(3) Remove the rear frame.
(4) Remove the mounting bolts attaching the main generator to the skid.
(5) Remove the bolts attaching the flexible coupling disc to the periphery of the flywheel.
(6) Remove the generator by sliding it away from the engine.

g. Disassembly of the Main Generator (Fig. 4).

(1) Remove the generator flexible coupling disk and generator fan.
(2) Remove the baffle rings.
(3) Remove the brushes from the brush holders.
(4) Remove the bearing bolts and bearing retainers.
(5) Remove the rotor assembly from the stator.

h. Assembly of the Main Generator. Follow the reverse procedures set forth in paragraph *f.* above.

i. Installation of Main Generator. Follow the reverse procedures set forth in paragraph *f.* above.

22. Control Group

a. General. Keep the control cabinet assembly free of dust, dirt and other foreign matter that may cause electrical malfunctions. See that control knobs are secure and that switches have proper action.

b. Current Transformer. Used in conjunction with the ammeters. Each opening has one turn of lead wire. Check mounting.

c. Meters. Keep meters clean. Check readings periodically with external meters.

d. Repair, Removal, Installation. Limit repair to cleaning and replacement of parts. Depending upon the amount of repair that may be required, consider removing the complete control box from the unit for work at a more convenient location. No special techniques are required as all components are secured with standard hardware. However, observe how parts are installed before removal. When installing parts be sure that the wiring connections are correct; check against wiring diagram.

e. Static Exciter (fig. 40). The static exciter consists basically of 3 DC controller, single-phase, current voltage transformers (CVT), 3 single-phase reactors and a three-phase, full-wave rectifier assembly. It provides excitation current for the main generator field and has two modes of operation: One, when the generator is operating under a no-load condition, the other with the generator operating under load. The components of the exciter are mounted in a single box, located on the component tray behind the control panel (fig. 2).

Figure 40. Schematic diagram voltage regulator and exciter.
Located in back of manual.

f. Static Exciter Removal (fig. 58).

(1) Disconnect the electrical connectors.
(2) Remove the perforated cover.
(3) Disconnect wires T1, T2, T3, T7, T8, T9, TT1, TT2, TT3, TT7, TT8, TT9, F1 and F2 (figure 40).
(4) Remove the 4 mounting bolts attaching the exciter to the assembly tray.

g. Inspection Cleaning and Repair.

(1) Clean all parts with a clean cloth dampened with an approved cleaning solvent and dry thoroughly.
(2) Check for defective insulation, loose or broken leads.
(3) If the static exciter is defective, return it for repair.

h. Installation of Static Exciter. Install with reverse procedures of paragraph *f.* above.

i. Voltage Regulator (fig. 40). The voltage regulator consists of coupled transformers, and silicon controlled rectifiers (SCR), synchronized with other transistors, resistors and capacitors. The voltage regulator compares a portion of the generator output with the rated voltage. The difference generates an error signal that is used to establish the level of control current applied to the static exciter. This control current through the static exciter maintains the generator terminal voltage within the required limits for various load conditions. The voltage regulator is controlled by a rheostat located on the control panel. By turning the rheostat the voltage output of the generator set can be increased or decreased. The assembly is mounted on the component tray adjacent to the static exciter (fig. 40).

j. Voltage Regulator Removal.

(1) Disconnect the electrical connectors.
(2) Disconnect the clamp and bolt.
(3) Remove four hex bolts and spacers.
(4) Remove voltage regulator from box.

k. Voltage Regulator Disassembly.

(1) No special procedures are required for disassembly.
(2) Be sure to mark all parts for reassembly.

l. Voltage Regulator Inspection, Cleaning and Repair.

(1) Clean all parts with a clean cloth dampened with an approved cleaning solvent and dry thoroughly.
(2) Inspect the resistors and transistors for damaged terminals, defective insulation, and other visible damage.
(3) Inspect the capacitors for broken leads or cracked cases.
(4) Inspect the transformers and chokes for cracks, breaks, broken terminals, and evidence of overheating.
(5) Inspect the chassis for cracks, breaks, and other damage. Inspect threaded parts for defective threads.
(6) Repair or replace defective parts as necessary.

m. Testing Voltage Regulator (fig. 40).

(1) Test all transistors and capacitors using suitable transistors and capacitor test equipment.
(2) Test all resistors using an ohmmeter. The one thru-blot mounted resistor should measure within ± 10 percent of their rated values. All resistors soldered to the panel boards should measure within 10 percent of their rated values.
(3) Test chokes and transformers for continuity using an ohmmeter. Test the chokes and transformers for grounds by testing between one lead of each winding and the core with a multimeter. Test each transformer for shorted windings by testing between one lead of the secondary winding and one lead of the primary winding.
(4) Test the diodes for shorts or opens using an ohmmeter. When testing the diodes, connect the leads to the ohmmeter in such a way as to isolate the diode from other diodes and surrounding circuitry. A normal diode will indicate very low resistance in one direction and extremely high in the other. If the diode is shorted, very low resistance will be indicated

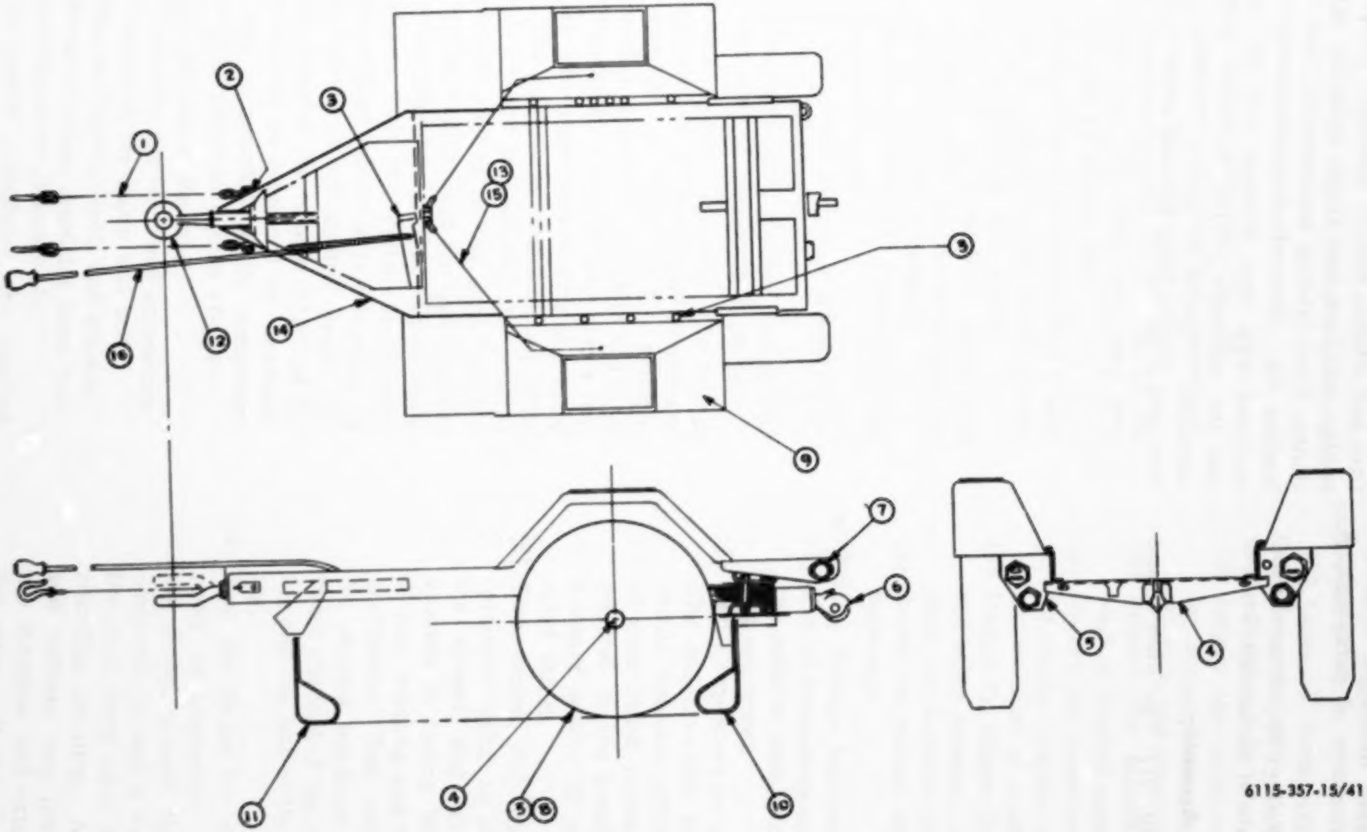
in both directions. An open diode will read infinite in both directions.

n. Reassembly Voltage Regulator. Reassembly with reverse procedures of paragraph, *j* above.

o. Installation of Voltage Regulator. Install with reverse procedure of paragraph, *k* above.

23. Wheel-Mount Assembly

a. Description (fig. 41). The wheel-mount-assembly provides the mount for the generator set. It includes the axle assembly, suspension parts, parking brake and brake control, tires and wheels, coupler assembly, pintle assembly, wishbone type frame assembly, safety chains, front landing leg assembly, and rear landing leg. The wheel-mount assembly is equipped with stop, blackout and tail lights and the necessary wiring harnesses and receptacles. Figures 50 and 51 illustrates the rear and front wiring harness assemblies.



1 Safety chain assembly
2 Safety chain anchor spacer
3 Brake control
4 Axle assembly
5 Tire and wheel assembly
6 Pintle assembly
7 Red reflector
8 Tire and wheel assembly
9 Splash guard assembly
10 Rear landing leg assembly
11 Front landing assembly
12 Coupling assembly
13 Cable assembly
14 Frame assembly
15 Brake cable
16 Electrical system assembly

Figure 41. Wheel Mount Assembly.

b. Wheel-Mount Handbrake. Removal and Disassembly (fig. 42).

(1) Remove lubrication fitting from the conduit and cable assembly.

(2) Remove two screws, nuts, washers and clamps securing cable and conduit assembly to the wheel-mount frame.

(3) Remove nuts, washers and screws securing rod end to the brake lever and remove the rod end from the lever.

(4) Remove cotter pin and clevis pin securing the rod end clevis to yoke assembly and remove the clevis from the yoke.

(5) Remove rod end clevis and nut from cable assembly.

(6) Remove nut and rod end from the other end of cable assembly and pull the cable out of the conduit.

(7) Remove two nuts from conduit and remove the conduit.

(8) Repeat this operation on the opposite brake cable.

(9) Remove cotter pin and clevis pin securing yoke assembly to the brake lever and remove the yoke.

(10) Remove nuts, washers and screws from the hand brake lever assembly and remove the lever assembly.

Reassembly and Installation

(1) Position yoke assembly on the brake lever and secure with clevis pin and cotter pin.

(2) Position lever assembly on the wheel-mount frame and secure with screws, washers and nuts.

(3) Position conduit on the wheel-mount frame and secure with two nuts.

(4) Slide cable assembly in conduit and install nut and rod end on the cable.

(5) Install nut and rod end clevis on the opposite end of the cable assembly.

(6) Place the brake lever in the "off" position, adjust the rod end clevis to give a ⅝ inch travel at the yoke, and lock the yoke with nut.

(7) Position clevis on yoke assembly and secure with clevis pin and cotter pin.

(8) Install the lubrication fitting in the conduit and cable assembly.

(9) Position clamp on the conduit and cable assembly and secure with screw, washer and nut.

(10) Repeat the above operations on the opposite brake cable.

(11) Lubricate the brake cables in accordance with the current lubrication order.

(12) Adjust the brakes; procedure below.

Brake Adjustment

(1) Check action of the handbrake to see if brakes are being properly applied through the action.

(2) Jack up the wheel, turn the adjustment fitting in the position of high adjustment as indicated by the arrow. The arrow points out for high adjustment and in for low adjustment.

(3) Turn the wheel, tighten the adjustment screws until the wheel stops.

(4) Back the adjustment screw off one-half a turn and remove the jack.

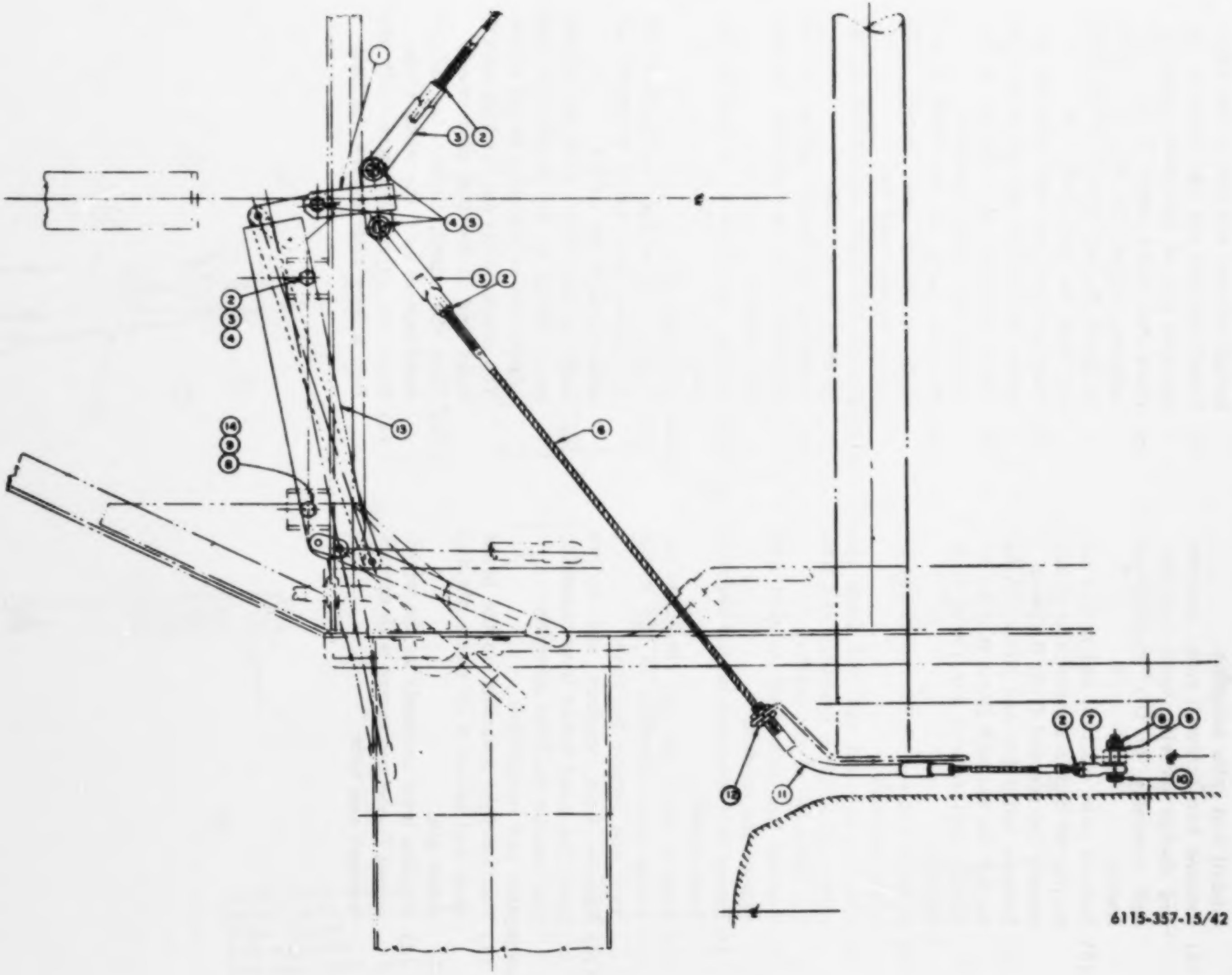

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Figure 42. Wheel mount handbrake.

Refer to Figure 42.

1 Yoke assembly
2 Nut, plain, hex, jam, 3/8-24
3 Rod End Clevis
4 Clevis Pin
5 Cotter Pin 3/32 x 3/4 in.
6 Cable Assembly
7 Spherical Rod End 3/8-24
8 Nut, plain hex, 3/8-24
9 Washer, lock, 3/8 in.
10 Screw, cap, hex, 3/8-24 x 1 3/4 in. Long
11 Conduit
12 Conduit Nut
13 Lever Assembly, Handbrake
14 Screw, Cap, Hex, 3/8-24 x 1 1/4 in. Long

c. *Wheel-Mount Front Landing Leg (fig. 43).*

Removal and Disassembly

(1) Set the brakes and block up the wheel-mount assembly.

(2) Remove lock pin from the safety pin, pull the safety pin from the landing leg bracket and lower the landing leg.

(3) Remove nut, washer, securing hook and safety chain to the wheel-mount frame.

(4) Remove nut, and screw from bracket and remove the landing leg assembly.

(5) Remove two screws and nuts securing landing leg to bracket and separate the leg and bracket.

Cleaning and Inspection

(1) Wash all parts in an approved cleaning solvent and dry thoroughly.

(2) Inspect the safety chain, lock pins, and hardware for damage. Replace defective parts.

Reassembly and Installation

(1) Position landing leg on bracket and secure with two screws and nuts.

(2) Position the assembled landing leg and bracket on the wheel-mount frame and secure with screws and nut.

(3) Install hook on safety chain to the wheel-mount frame and secure with washer and nut.

(4) Lower the landing leg, install safety pin and secure with lock pin.

(5) Remove the wheel-mount blocking and release the brakes.

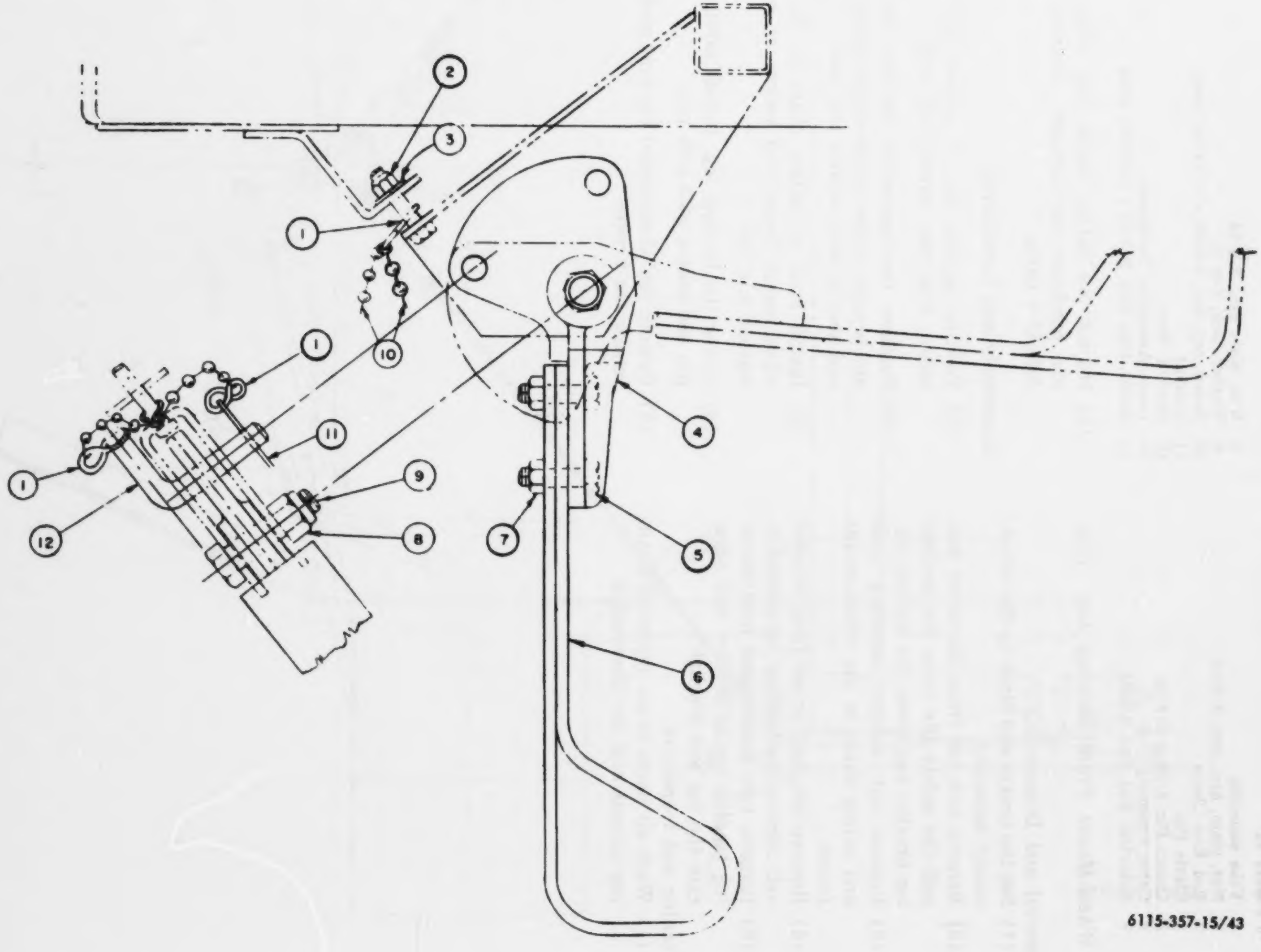
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Figure 43. Front landing leg assembly.

1 Hook-S
2 Nut, self locking, 3/8-24
3 Washer, flat, 3/8 in.
4 Landing leg bracket
5 Screw, cap, hex, 1/2-20 x 1 3/4
6 Landing leg
7 Nut, self locking 1/2-20
8 Nut, self locking 3/4-20
9 Screw, cap, hex, 3/4-16 x 2 3/4 in. long
10 Safety chain
11 Lock pin 2-1/4 in. long
12 Safety pin

d. Wheel-Mount Rear Landing Leg (fig. 44). Remove, clean, inspect and install the rear landing leg using the same procedure except for removal of the S hook, which is attached in a hole in the wheel-mount support.

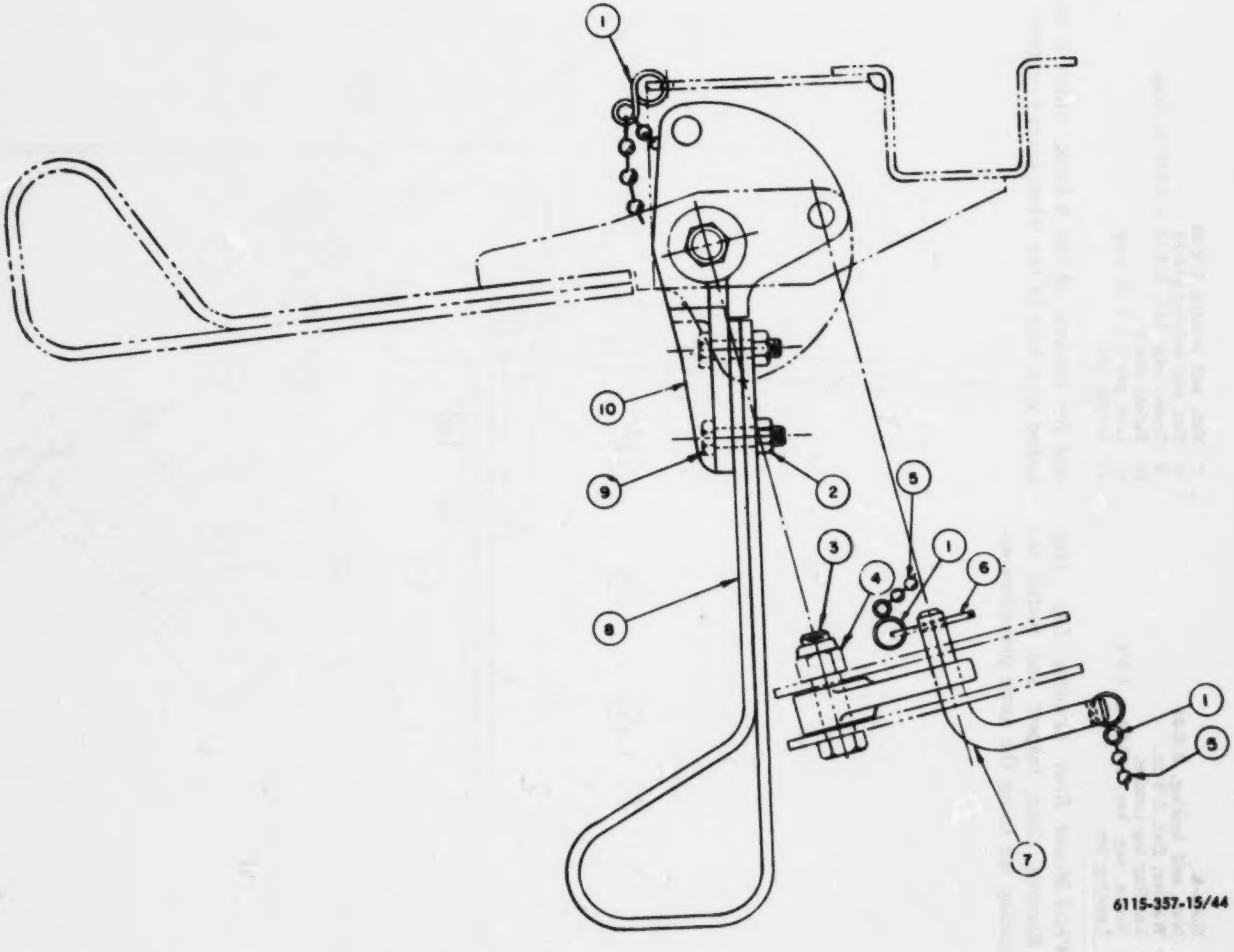
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Figure 44. Rear landing leg assembly.

1 Hook-S
2 Nut, self locking, 1/2-20
3 Screw, cap, hex, 3/4-16 x 2 3/4 in. long
4 Nut, self locking 3/4-16
5 Chain, safety
6 Pin, lock, 2 1/4 in. long
7 Pin Safety
8 Leg landing
9 Screw, cap, hex 1/2-20 x 1 3/4 in. long
10 Bracket, landing leg

e. *Wheel-Mount Rear Pintle Hook* (fig. 45)

Removal and Disassembly

(1) Remove the hex nuts, lockwashers, and bolts securing the rear pintle hook assembly to the wheel-mount frame and remove the pintle hook assembly and mounting gasket.

(2) Remove the two lubrication fittings from the pins.

(3) Remove two retaining rings, securing body pin in the body.

(4) Drive body pin through lock body and hook, and remove latch and spring from the body.

(5) Remove two retaining rings from hook pin, drive the pin out and remove body from hook.

Cleaning and Inspection

(1) Wash all parts in an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for damage or wear. Replace all defective parts.

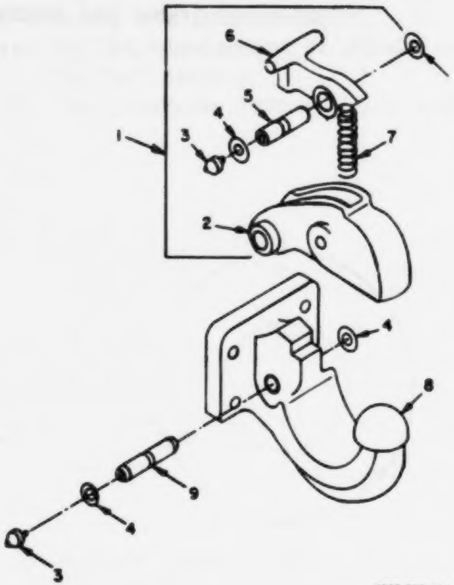
Reassembly and Installation

(1) Position latch and spring in lock body and secure with body pin and two retaining rings.

(2) Position the assembled lock body on hook and secure with hook pin and two retaining rings.

(3) Position a new gasket and the assembled pintle hook on the wheel-mount frame and secure with four bolts, lockwashers and hex nuts.

(4) Install the lubrication fittings in pins and lubricate in accordance with the current lubrication order.



6115-357-15/4

1 Lock assembly
2 Body lock
3 Lubrication ring
4 Retaining ring
5 Body pin
6 Latch
7 Spring, latch
8 Hook
9 Hook pin

Figure 45. Rear pintle hook assembly.

f. Wheel-mount Towing Coupler Assembly (figure 46).

Removal

(1) Remove cotter pin, slotted nut, and washer from the end of the draw bar coupler and remove the drawbar coupler from the coupler bracket.

(2) Remove the three hex nuts, lockwashers, and screws securing the bracket coupler to the wheel-mount frame and remove the coupler bracket.

Cleaning and Inspection

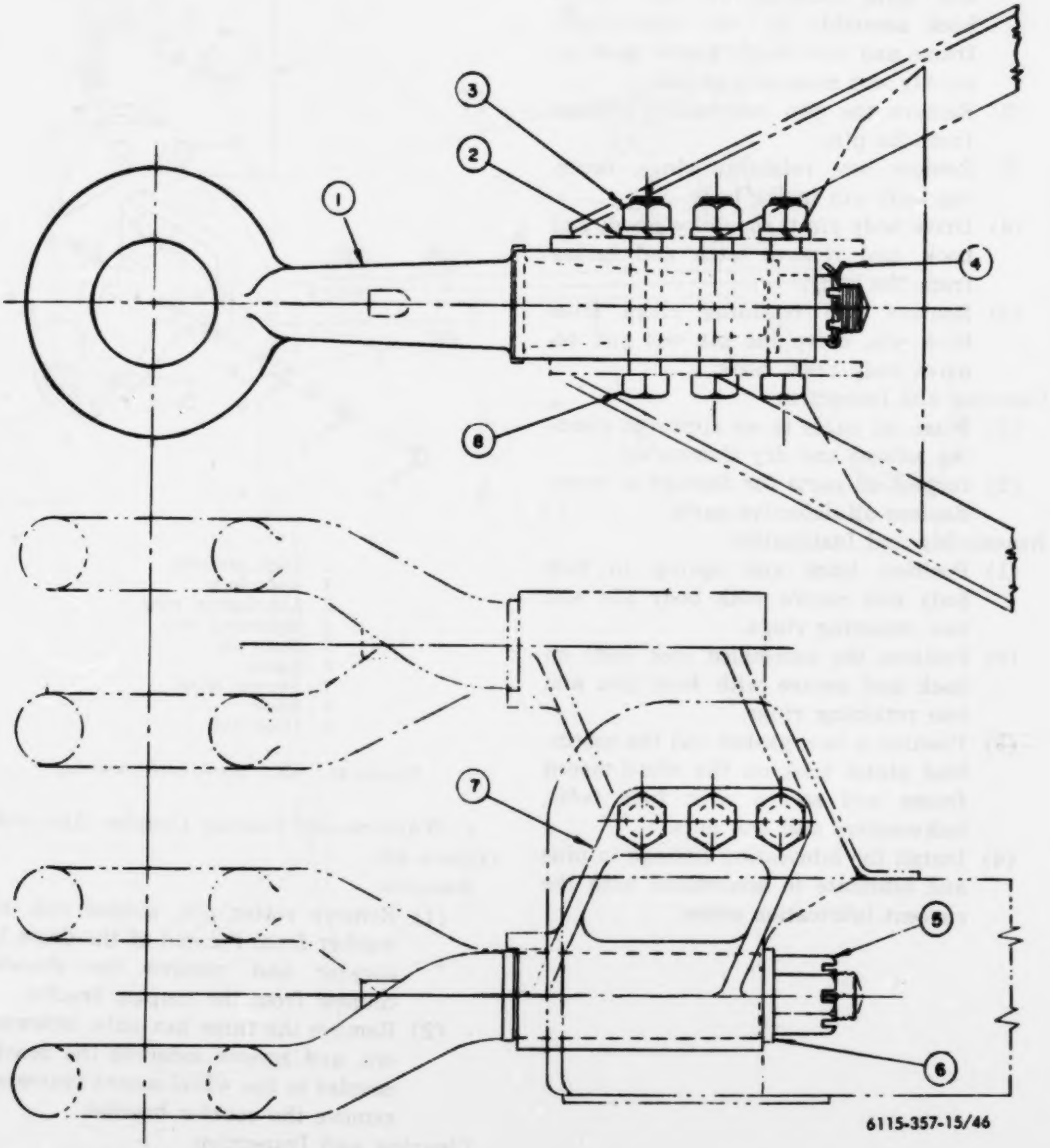
(1) Wash all parts thoroughly with an approved cleaning solvent and dry thoroughly.

(2) Inspect the coupler assembly for damaged hardware or parts. Replace all defective parts.

Installation

(1) Position the coupler bracket on the wheel-mount frame and secure with three screws, lockwashers and hex nuts.

(2) Install the drawbar coupling in the coupler bracket and secure with washer, nut and cotter pin.

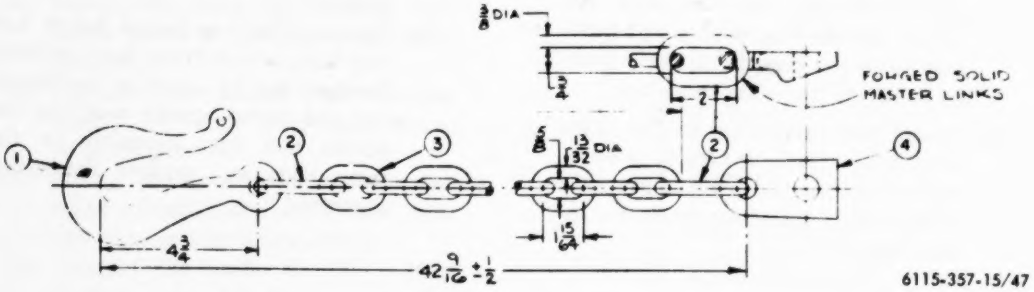


1 Draw bar coupler
2 Washer, lock, 3/4 in.
3 Nut, plain, hex 3/4-10
4 Pin, cotter, 3/16 x 2 in. long
5 Nut, slotted, 1/2-12
6 Washer, coupler
7 Coupler bracket
8 Screw, cap, hex hd., 3/4-10 x 4 in. Long

Figure 46. Wheel mount coupler assembly.

g. Wheel-mount Safety Chain (fig. 47). The two safety chains are provided for securing the wheel-mounted generator set to the prime mover or the tandem hitch. They are secured to the front of the wheel-mount frame and can be removed by removing hex screw nut and lockwasher which secures the chain anchor to the frame.

h. Wheel-mount Fenders and Spring Bumpers (fig. 41).



1 Safety chain hook
2 Chain bar
3 Chain assembly, welded
4 Chain anchor

Figure 47. Wheel mount safety chain assembly.

(1) *Removal.*
  - *(a)* Remove the hex screws, nuts, and lockwashers securing the two splash guard assemblies to the wheel-mount frame.
  - *(b)* Remove the two axle bumpers and the bumper spacers which are secured by a finder screw directly over the wheel-mount axle.

(2) *Cleaning and Inspection.*
  - *(a)* Clean the fenders thoroughly and inspect them for chipped paint or damage. Repaint and repair as necessary.
  - *(b)* Inspect the spring bumper for damage and wear, replace if necessary.

(3) *Installation.*
  - *(a)* Position the splash guard assemblies on the wheel-mount frame.
  - *(b)* Position the spring bumper spacer and the spring bumper over the center bolt above the wheel-mount axle and secure with lockwasher and hex nut.
  - *(c)* Install the remaining screws in the fender, and secure to the wheel-mount frame with screws, lockwashers and hex nuts.

i. Wheel-Mount Wheel and Tire Assembly.

(1) *Removal and Disassembly.*
  - *(a)* Set the wheel-mount handbrake in the "on" position.
  - *(b)* Use a suitable hydraulic jack and jack up the wheel and tire assembly.
  - *(c)* Remove the five nuts securing the tire and wheel assembly to the brake drum and remove the tire and wheel.
  - *(d)* Remove the valve cap, and valve core from the valve stem and deflate the tire.
  - *(e)* Place the wheel and tire on a level surface with the tire lock ring up.
  - *(f)* Use a suitable tire tool and remove the tire lock ring from the tire and wheel. Remove the wheel from the tire.
  - *(g)* Remove the tire flap and tube from the tire.

(2) *Cleaning and Inspection.*
  - *(a)* Clean the wheel with a wire brush and an approved cleaning solvent and dry thoroughly.
  - *(b)* Inspect the wheel studs and nuts for damaged threads.

(c) Inspect the tire, tube and tire flap for cuts, bruises, or other damage.

(d) Replace all defective parts.

(3) *Reassembly and Installation.*

(a) Position the tube and flap into the tire and inflate until the tube assumes a normal shape.

(b) Position the valve stem in the slot provided in the wheel and press the tire on the wheel.

(c) Position one end of the lock ring in place between the tire and the wheel, tap the ring with a soft hammer until the ring is properly seated between the wheel and tire.

(d) Install the valve core in the valve stem and inflate the tire 50 pounds. Make sure the lock ring is properly seated while inflating the tire. Install the valve cap.

j. Wheel-Mount Blackout, Tail and Stoplights (fig. 48).

(1) *Removal and Disassembly.*

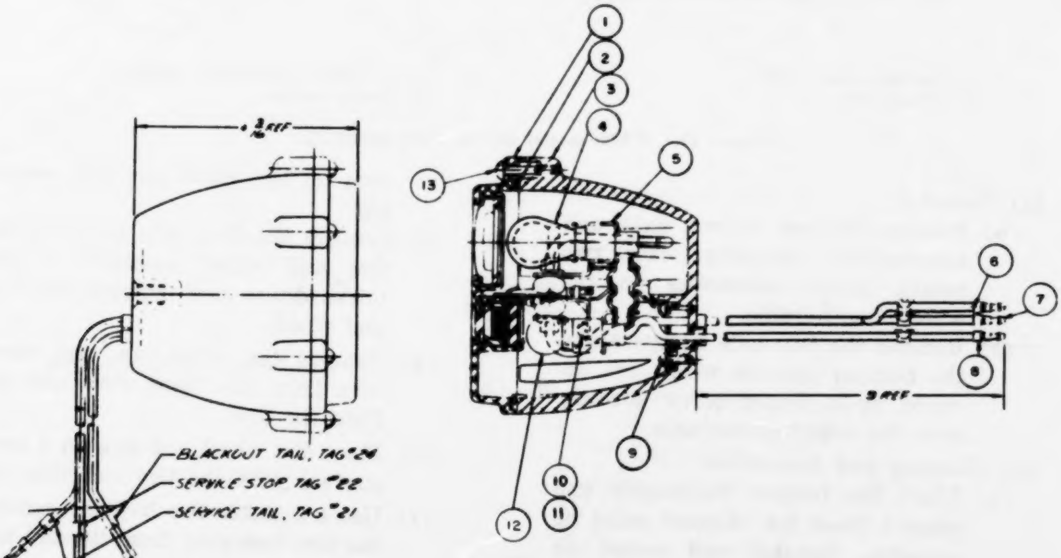
(a) Tag and disconnect the three leads at the wheel-mount frame.

(b) Remove the two screws securing the lamp body to the wheel-mount frame and remove the lamp assembly.

(c) Remove six screws securing the door assembly to the lamp body and remove the door assembly and door gasket.

(d) Remove the two lamps below and one lamp above from their sockets.

(e) Remove the two screws, lockwashers and three screws securing the socket and wire assembly in the lamp body and remove the socket assembly.



1 Door assembly
2 Door gasket
3 Lamp body
4 Incandescent lamp
5 Socket and wire assembly
6 Service tail lead
7 Service stop lead
8 Blackout tail lead
9 Screw
10 Screw
11 Washer, lock
12 Incandescent lamp
13 Screw, door

Figure 48. Lamp assembly, blackout, tail, and stop.

(2) *Cleaning and Inspection and Repair.*

(a) Clean all parts with an approved cleaning solvent and dry thoroughly.

(b) Inspect the connections, wires, door and gasket for damage. Replace all defective parts.

(3) *Reassembly and Installation.*

(a) Install the socket and wiring assembly in the lamp body and secure with three screws, two lockwashers and screws.

(b) Install the lamp above and two lamps below in the socket and wire assembly.

(c) Position door gasket and door assembly on lamp body and secure with six screws.

(d) Install the lamp assembly on the wheel-mount frame and secure with two screws and lockwashers.

(e) Connect the leads to the wiring harness assembly and remove the tags.

k. Stop Light Blackout (fig. 49).

(1) *Removal and Disassembly.*

(a) Disconnect the lead at the blackout stop light.

(b) Remove two hex nuts and lockwashers securing the blackout stop light to the wheel-mount frame and remove the light.

(c) Remove two screws securing door assembly to the body and remove the door and door gasket.

(d) Remove lamp from socket and wiring assembly.

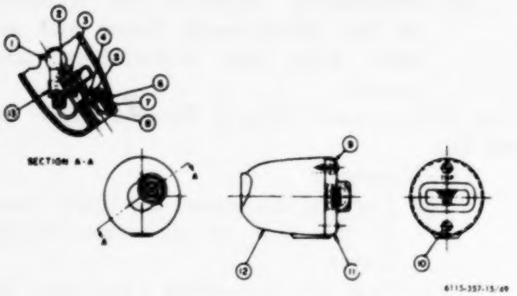
(e) Remove screws, washers, isolator, and socket and wiring assembly from the lamp body.

(f) Remove speed nut, shell and terminal from the lamp body.

(2) *Cleaning and Inspection.*

(a) Clean all parts with a cloth dampened with approved cleaning solvent and dry thoroughly.

(b) Inspect the hardware, socket, terminals and wires for damage. Replace all defective parts.



1	Incandescent lamp
2	Screw
3	Insulator
4	Washer
5	Washer
6	Speed nut
7	Shell
8	Terminal
9	Door gasket
10	Screw
11	Door assembly
12	Lamp body
13	Socket and wire assembly

Figure 49. Stop light, vehicular blackout.

(2) *Reassembly and Installation.*

(a) Position shell and terminal in the lamp body and secure with speed nut.

(b) Install isolator and socket and wire assembly in the lamp body and secure with washers and screws.

(c) Install lamp in socket and wire assembly.

(d) Position gasket and door assembly on the lamp body and secure with two screws.

(e) Position stop light on the wheel-mount frame and secure with two hex nuts and lockwashers.

(f) Connect the lead to the stop light.

l. Reflectors (fig. 41).

(1) *Removal.* Remove the two screws and lockwashers securing the two reflectors to the wheel-mount frame and remove the reflectors.

(2) *Cleaning and Inspection.* Clean all parts thoroughly and inspect the reflectors for damage. Replace a defective reflector.

(3) *Installation.* Position the reflector on the wheel-mount frame and secure with two lockwashers and screws.

m. Wheel-mount Wiring Harness (figs. 50 *and* 51*).*

(1) *Removal.*

(a) Tag and disconnect the three leads at the rear of the wheel-mount frame.

(b) Tag and disconnect the leads at the wiring harness assembly.

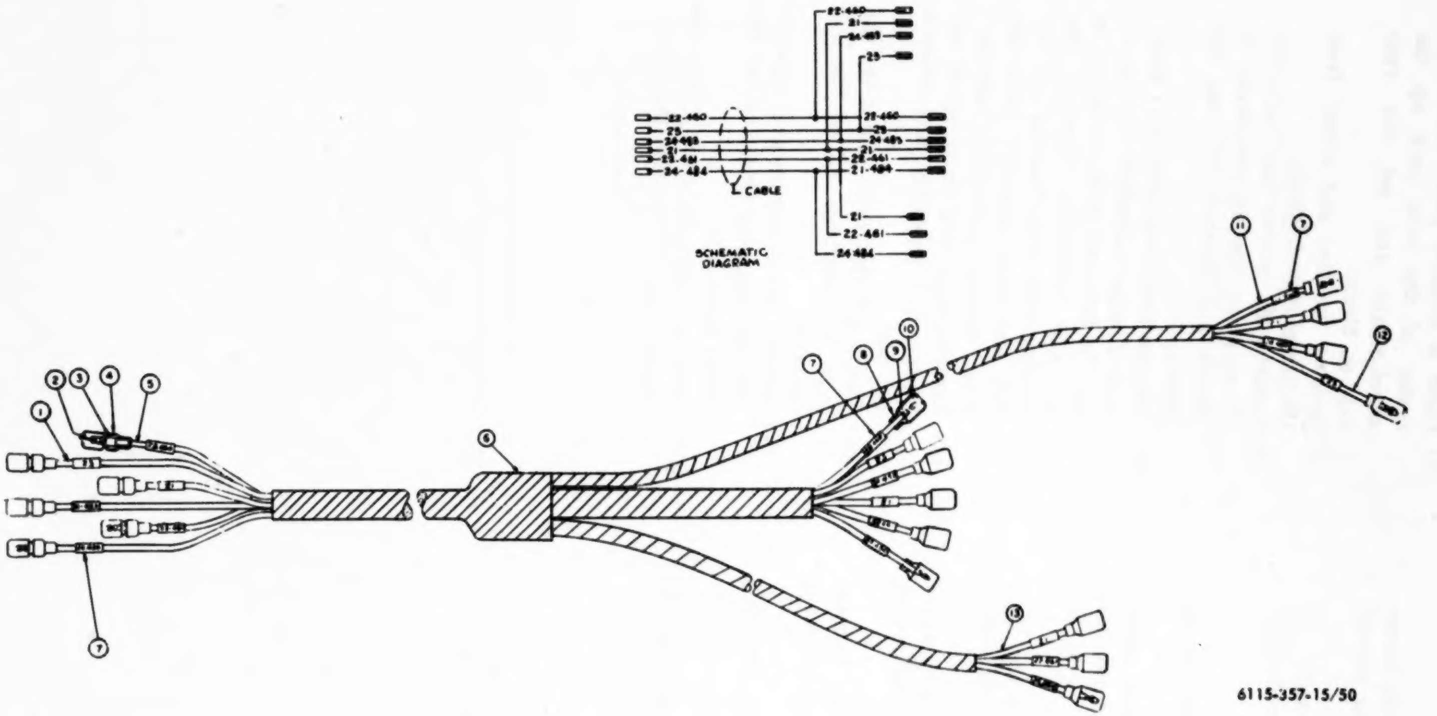
(c) Remove nuts, washers and screws from clamps.

(d) Disconnect retainer and spring and remove the spring and retainer.

(e) Remove nuts, washers and screws from clamps.

(f) Disconnect the ground wire and remove the harness assembly from the wheel-mount frame.

(g) Separate harness assembly from harness and remove grommets and clamps.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21-484
CABLE
21
22-461
24-484
SCHEMATIC DIAGRAM
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1	Cable, electric, single conductor no. 14 x 92 in. long
2	Terminal, female
3	Sleeve, terminal
4	Shell, male connector
5	Cable, electrical, single conductor no. 14 x 90 in. long
6	Tape, electrical
7	Band marker
8	Washer
9	Shell, female connector
10	Terminal, male
11	Cable, electrical, single conductor, no. wire x 33 in. long
12	Cable, electrical, single conductor, no. 14 x 39 in. long
13	Cable, electrical, single conductor, no. 14 x 24 in. long

Figure 50. Wheel mount wiring harness assembly, rear.

(2) *Cleaning and Inspection.*

(*a*) Clean all parts with a cloth dampened in approved cleaning solvent and dry thoroughly.

(*b*) Inspect the harness assembly for cracks or breaks or other damage. Replace defective parts.

(3) *Installation.*

(*a*) Install the rubber grommets on the wiring harness assembly.

(*b*) Position the wiring harness assembly on the wheel-mount frame and connect the ground wire to the wheel-mount frame.

(*c*) Install clamps and secure the harness to the wheel-mount frame with screws, washers and nuts.

(*d*) Connect cable spring and retainer to clamp and the wheel-mount frame.

(*e*) Connect the leads on the harness assembly at the lights and remove the tags.

n. Wheel-mount Hub and Drum Assembly (fig. 52).

(1) *Removal.*

(*a*) Lower the landing leg and lock it in the down position.

(*b*) Place a suitable jack under the center of the axle, jack up the wheel-mount and set the rear axle on blocks.

(*c*) Remove the tire and wheel from the wheel-mount frame.

(*d*) Remove six screws and lockwashers securing the hub and drum assembly and remove the cap and gasket.

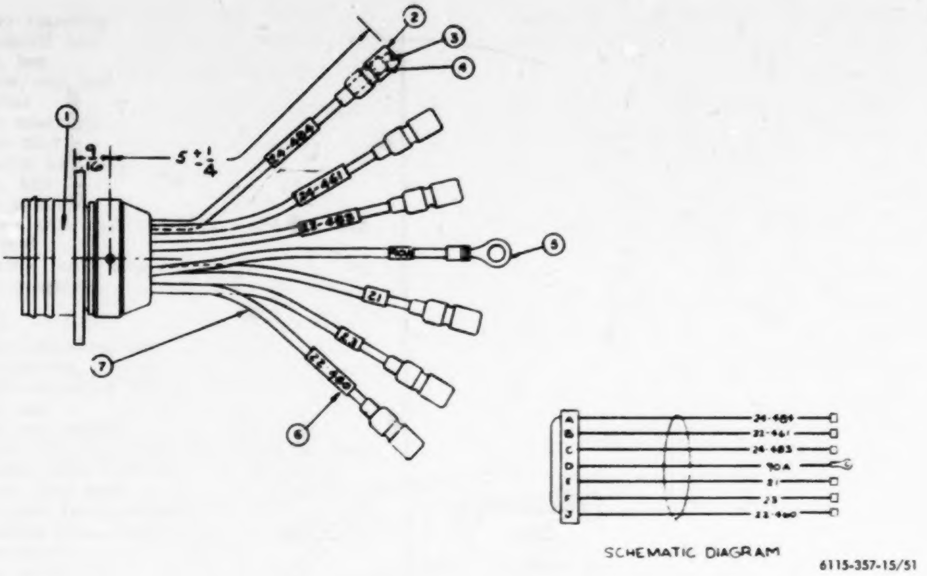
(*e*) Remove outer adjusting nut, washer and inner adjusting nut securing the hub and drum assembly to the axle assembly. Remove the bearing cone from bearing and the hub and drum assembly from the axle. Remove cone from bearing.

(*f*) Remove snap ring securing oil seal in the hub assembly and remove the seal.

(*g*) Use a suitable drift and drive the cups for bearings out of the hub assembly.

(*h*) Remove three screws and separate the hub assembly from the hub and drum assembly.

(*i*) Remove screw securing cover and remove the cover from the drum.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24-484
24-461
23-483
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E
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J
24-484
22-461
24-483
90A
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22-460
SCHEMATIC DIAGRAM
6115-357-15/51

1 **Receptacle connector**
2 **Connector shell**
3 **Female terminal**
4 **Terminal sleeve**
5 Terminal lug, no. 16 wire to 1/4 in. stud
6 Band market
7 Cable, electrical, no. 14 wire x 5 in. long

Figure 51. *Trailer Wiring Harness Assembly, Front.*

(2) *Cleaning and Inspection*

(*a*) Wash all parts thoroughly with an approved cleaning solvent and dry thoroughly.

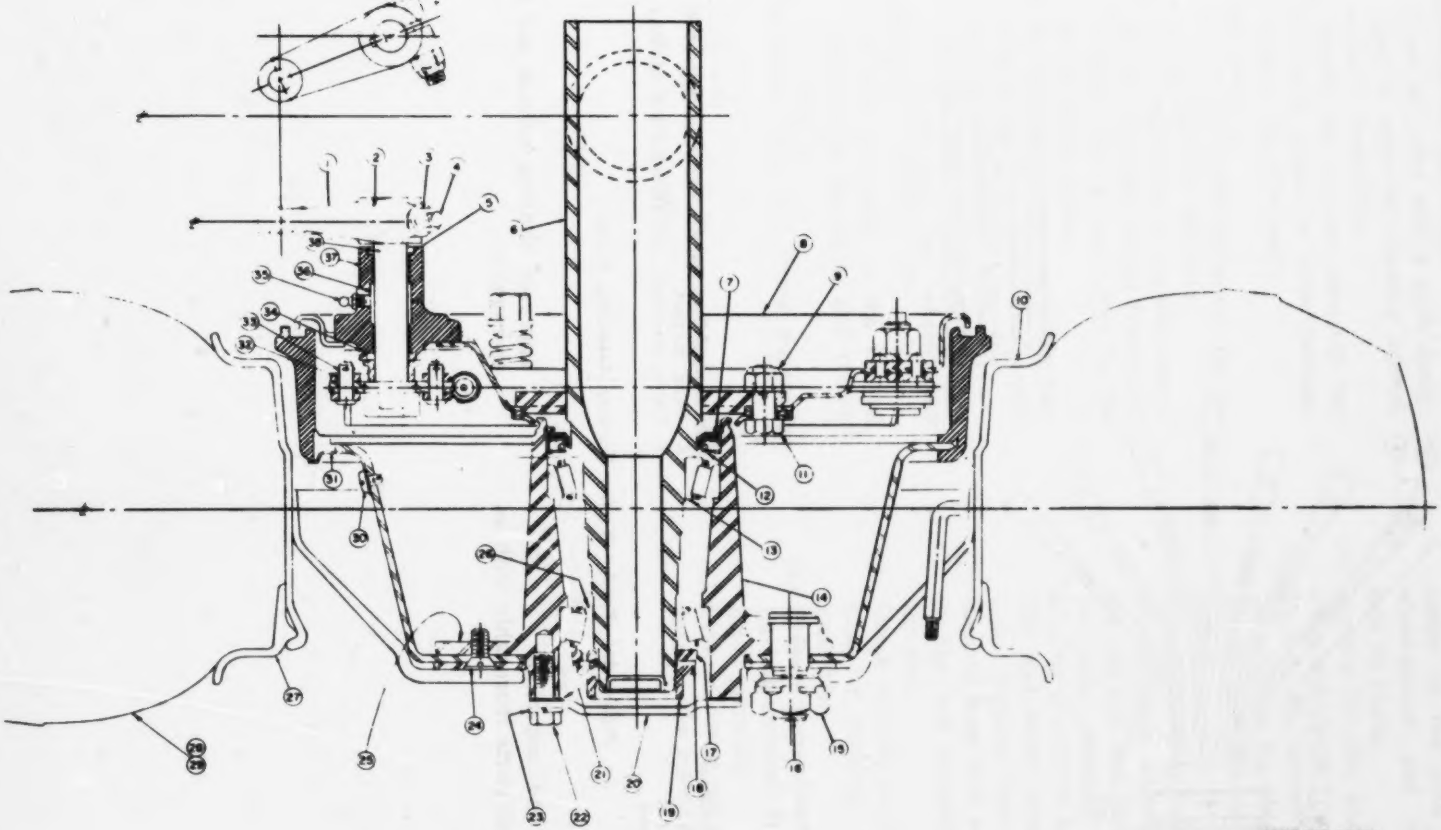
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Figure 52. Wheel mount, wheel, brake, hub and drum assembly.

1 Lever assembly
2 Woodruff key
3 Nut, hex
4 Screw, cap, hex
5 Washer
6 Axle assembly
7 Snap ring
8 Bracket assembly
9 Nut, hex
10 Rim assembly
11 Screw, cap. hex, 1/2-20 x 1-1/4 in. long
12 Oil seal
13 Bearing cone, single row
14 Hub assembly
15 Nut
16 Stud
17 Inner adjusting nut
18 Hub bearing washer
19 Outer adjusting nut
20 Hub cap
21 Hub cap gasket
22 Screw, cap, hex 7/16-14 x 1 1/4 in. long
23 Washer, lock, 7/16 in.
24 Screw, flat head
25 Hub and drum assembly
26 Bearing, cone, single row
27 Tire ring
28 Tire, 9:00 x 16
29 Tube, 9:00 x 16
30 Plate screw
31 Cover
32 Clevis pin
33 Pin, cotter
34 Spacer
35 Lubrication fitting
36 Bracket bushing
37 Bracket lever
38 Actuator shaft

(b) Inspect the axle bearings for pitted surfaces or excessive wear. Replace defective bearings.

(c) Inspect the hardware for damaged threads. Replace defective hardware.

(3) *Installation.*

(a) Position hub on the brake drum and secure with three flat head screws.

(b) Position cover on the hub and drum assembly and secure with screw.

(c) Position cups for bearings in the hub assembly. Use a suitable drift and drive them evenly into place.

(d) Position oil seal in the hub assembly and secure with snap ring.

(e) Pack the wheel bearings as prescribed in the current lubrication order.

(f) Install cone for the inner bearing, hub and drum assembly and cone for the outer bearing on the axle assembly and secure and adjust with inner adjusting nut.

(g) Install washer and outer adjusting nut and tighten securely.

(h) Position gasket and hub cap in the hub and drum assembly and secure with six lockwashers and screws.

(i) Install the wheel and tire assembly.

(j) Position a suitable jack under the axle and remove the blocking.

o. Wheel-mount Brakes (fig. 58).

(1) *Removal.*

(a) Remove the hub and drum assembly.

(b) Remove hex nut, lockwasher and screw securing rod end to the lever assembly and remove the clevis.

(c) Remove nut and screw securing lever assembly to the actuator shaft and remove the lever and woodruff key.

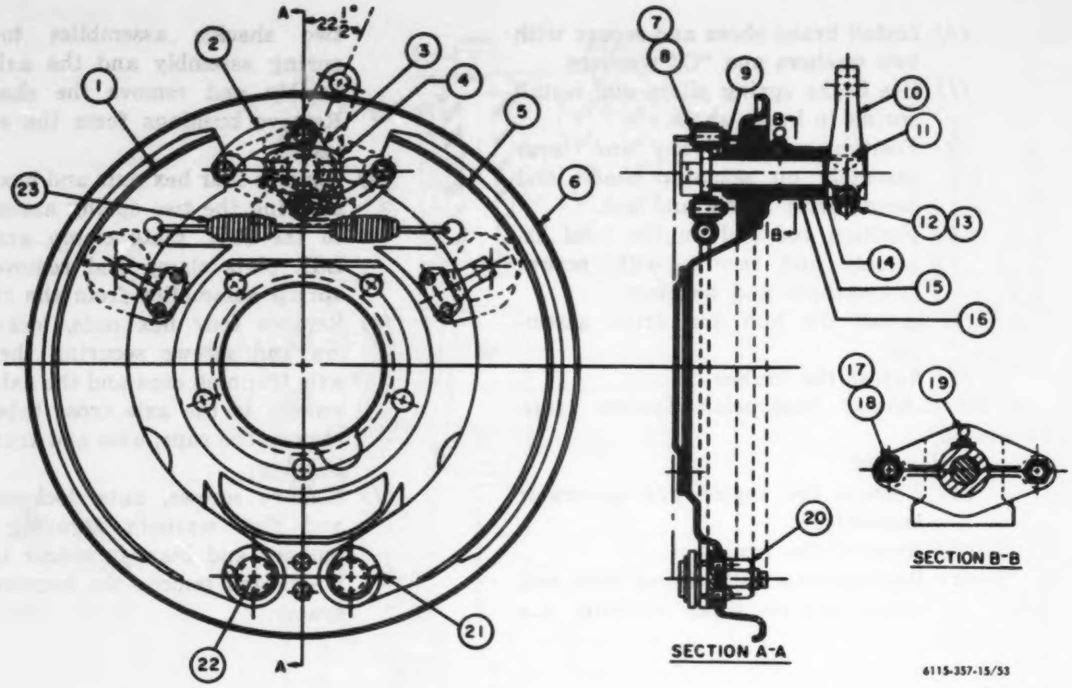
(d) Remove two "C" washers securing brake shoes to the brake shoe support plate.

(e) Use spring pliers and remove spring from shoes and remove the brake shoes.

(f) Remove two cotter pins, clevis pins and remove links, actuator and shaft from support plate.

(g) Remove two screws and nuts securing bracket to the support plate and remove the bracket and spacer.

(h) Remove five nuts and screws securing the brake shoe and support plate and remove the support from the axle assembly.



1	Brake shoe
2	Link
3	Actuator
4	Shaft
5	Brake shoe
6	Brake shoe and support plate
7	Clevis pin
8	Pin, cotter
9	Spacer
10	Lever
11	Woodruff key
12	Screw, cap, hex
13	Nut, hex
14	Washer, flat
15	Bushing
16	Bracket
17	Screw, cap, hex
18	Nut, hex
19	Fitting
20	Anchor nut
21	Washer "C"
22	Bolt, anchor
23	Spring shoe return

Figure 53. Wheel mount brake assembly.

(2) ***Cleaning and Inspection.***

(a) **Use compressed air and blow the dirt from the inside of the brake drums.**

(b) **Wash all parts in an approved cleaning solvent and dry thoroughly.**

(c) **Inspect the brake lining for excessive wear. Replace defective brake shoes.**

(d) **Inspect the return spring for excessive wear, cracks, or loss of tension. Replace defective springs.**

(e) **Inspect the brake drum for damage or excessive wear. Repair or replace a defective drum.**

(3) ***Installation.***

(a) **Position the brake shoe and support plant on the axle and secure with five nuts and screws.**

(b) **Install bushing felt washer and fitting in bracket.**

(c) **Position spacer and bracket on support plate and secure with two screws and hex nuts.**

(d) **Install the actuator shaft, links on the support plate and secure with two clevis pins and cotter pins.**

(e) Install brake shoes and secure with two washers and "C" washers.

(f) Use brake spring pliers and install spring in brake shoes.

(g) Position woodruff key and lever assembly on actuator shaft and secure with screw and nut.

(h) Position rod end on the level assembly and secure with screw, lockwashers and hex nut.

(i) Install the hub and drum assembly.

(j) Adjust the brakes.

p. Wheel-Mount Suspension System (figs. 54 and 55).

(1) *Removal.*

(a) Remove the engine and generator assembly.

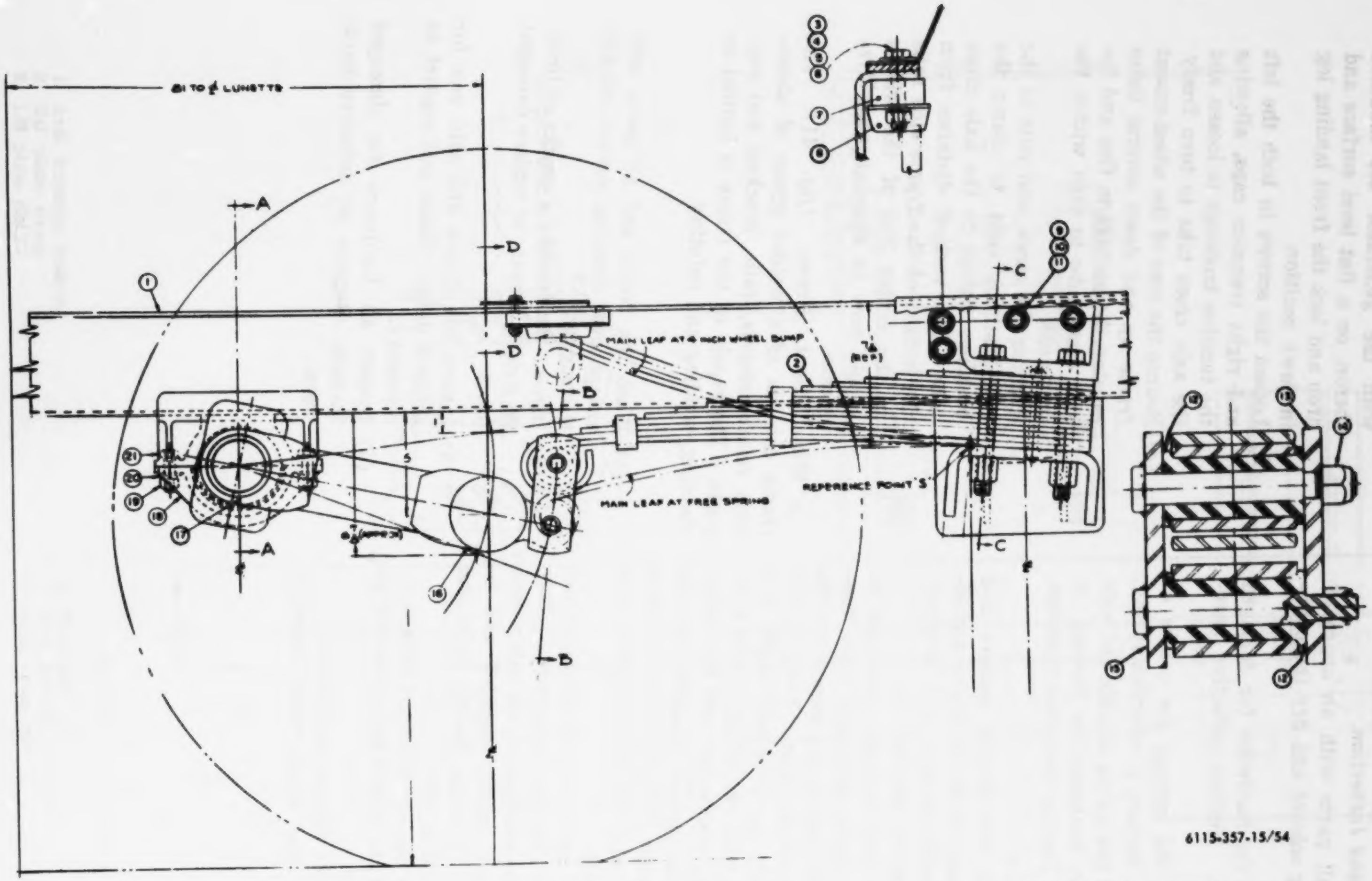
(b) Remove the brakes.

(c) Remove four self-locking nuts and outer shackle links securing the two shackle assemblies to the spring assembly and the axle assembly and remove the shackles. Remove bushings form the shackles.

(d) Remove four hex nuts and hex bolts securing the two spring assemblies to the R.H. plate clamp and the L.H. plate clamp and remove the spring assemblies from the frame.

(e) Remove four hex nuts, lockwashers and screws securing the two axle trunnion caps and the axles assembly to the axle cross tube and remove the caps, axle and trunnion bushing.

(f) Remove screws, nuts, lockwashers and flat washers securing axle bumper and bumper spacer to the frame and remove the bumper and spacer.


81 TO ℄ LUNETTE
A
D
B
C
MAIN LEAF AT 4 INCH WHEEL BUMP
MAIN LEAF AT FREE SPRING
REFERENCE POINT "S"
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6 7/8 (APPROX)
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6115-357-15/54

1 Trailer frame
2 Spring assembly
3 Screw, cap, hex, hd., 5/16-24 x 1 3/4 in. long
4 Flat washer, 3/8 in. I.D. x 7/8 in. O.D. x .084 in. thick
5 Washer, lock, 5/16 in.
6 Nut, plain, hex, 5/16-24
7 Axle bumper spacer
8 Axle bumper
9 Screw, cap, hex, 5/8-18 x 2 in. long
10 Washer, lock, 5/8 in.
11 Nut, plain, hex 5/8-18
12 Spring shackle bushing
13 Outer shackle link
14 Nut, self locking 5/8-18
15 Shackle assembly
16 Axle assembly
17 Axle trunnion bushing
18 Axle trunnion cap
19 Nut, hex
20 Washer, lock
21 Screw, cap, hex hd.

Figure 54. Wheel mount springs and shackles.

(2) *Cleaning and Inspection.*

(a) Clean all parts with an approved cleaning solvent and dry thoroughly.

(b) Inspect the hardware for damaged threads. Replace defective hardware.

(c) Inspect the springs for cracks or breaks. Replace a defective spring.

(d) Inspect the spring shackle and axle trunnion bushings for damage or wear. Replace defective bushings.

(3) *Installation.*

(a) Position tow bumper spacers and axle bumpers on the frame and secure with screws, flat washers, lockwashers and hex nut.

(b) Install two trunnion bushings on the trunnion and axle cross tube with the split in the bushing at the bottom of the tube. Position axle assembly on the cross, shaft and secure with two trunnion axle caps, screws, lockwashers and hex nuts.

(c) Position springs assembly in the R.H. plate clamp and the L.H. plate clamp and secure with bolts and hex nuts.

(d) Install the spring shackle bushings on the shackle assemblies. Position the shackles on the axle assembly and spring assembly and secure with outer shackle links and self-locking nuts.

(e) Install the wheel-mount brakes.

(f) Install the engine and generator assembly.

(4) *Suspension System Adjustment.*

(a) Place the wheel-mount assembly, with the generator set mounted theron, on a flat level surface and drop and lock the front landing leg in down position.

(b) Loosen the screws in both the left and right trunnion caps, allowing the tunnion bushings to loosen and the axle cross tube to turn freely.

(c) Bounce the rear of the wheel-mount frame up and down several times causing the springs to flex and the axle cross tube to turn within the trunnions.

(d) Tighten the screw and nuts to the axle trunnion caps to clamp the bushings tightly to the axle cross tube. The vertical distance from the bottom of the frame side rails to the center line of the wheels should now be approximately five inches.

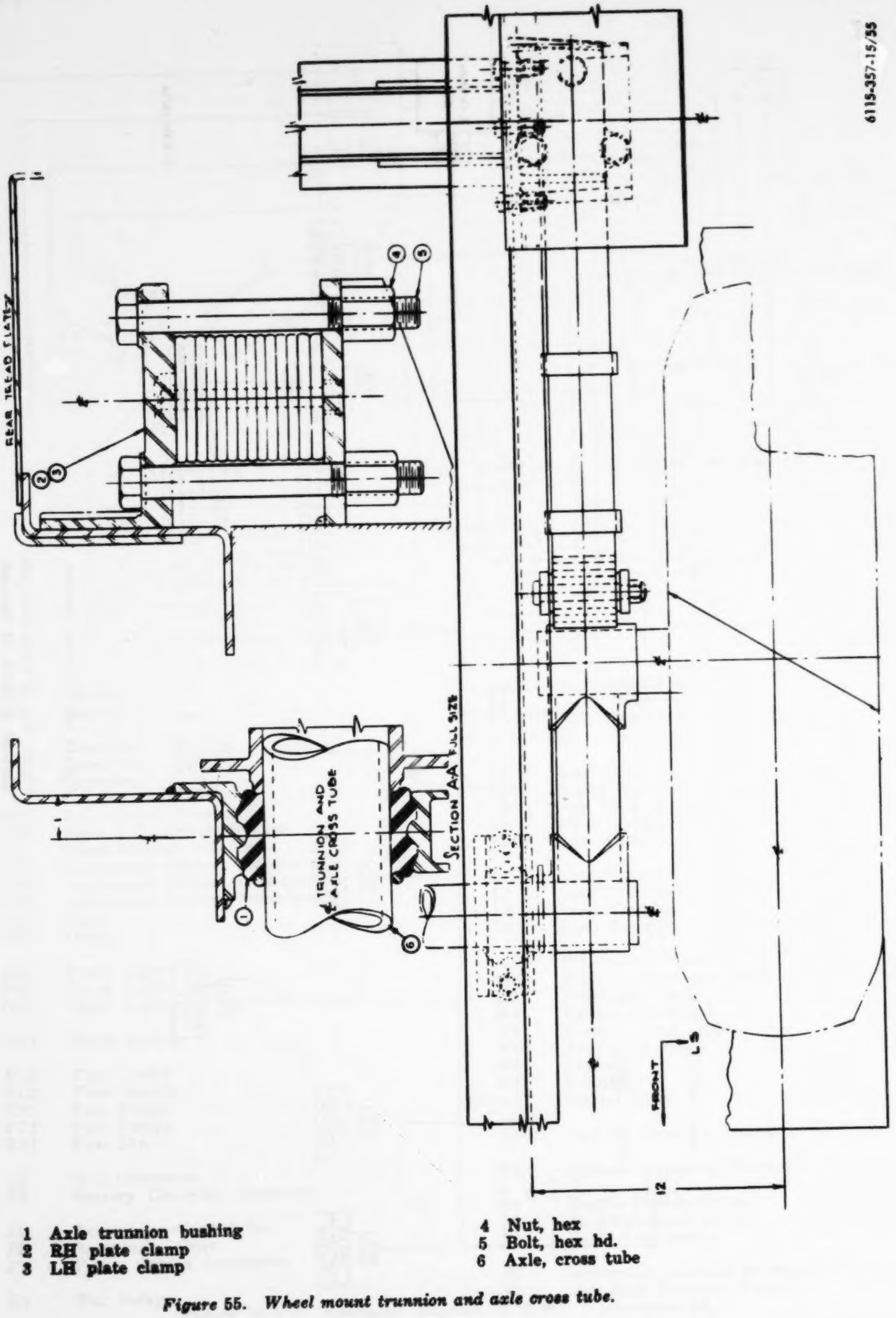
q. Wheel-mount Frame (fig. 41*).* The frame consists of a welded group of aluminum reinforcements, rails, brackets and supports. The repair of the frame is limited to cleaning, welding and painting.

(1) Wash the frame and all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect the frame for cracks or broken welds. Repair or replace damaged parts.

(3) Inspect the frame and skid pan for chipped paint. Clean and repaint as necessary.

(4) Inspect all hardware for damaged threads. Replace all defective hardware.


REAR TREAD PLATES
TRUNNION AND AXLE CROSS TUBE
SECTION A-A FULL SIZE
FRONT
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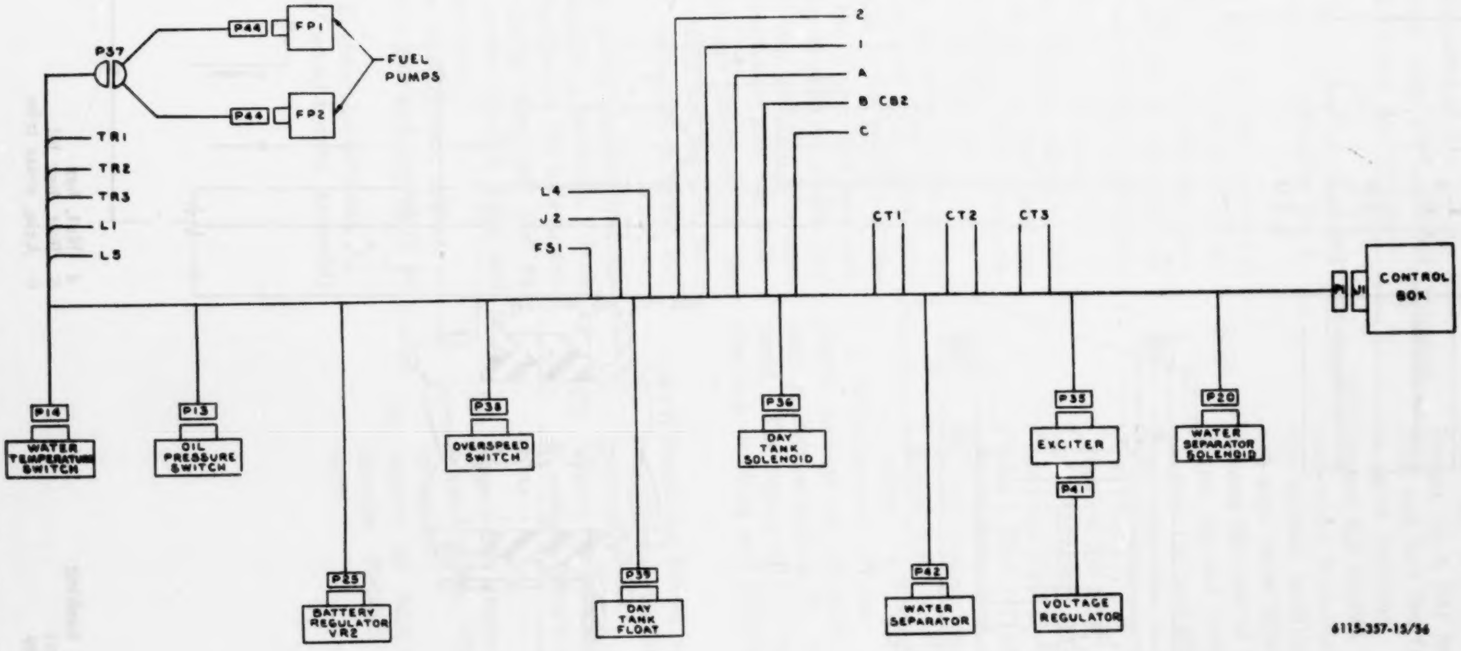
6115-357-15/55

1 **Axle trunnion bushing**
2 **RH plate clamp**
3 **LH plate clamp**
4 **Nut, hex**
5 **Bolt, hex hd.**
6 **Axle, cross tube**

Figure 55. Wheel mount trunnion and axle cross tube.


P37
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FP1
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FUEL PUMPS
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L5
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FS1
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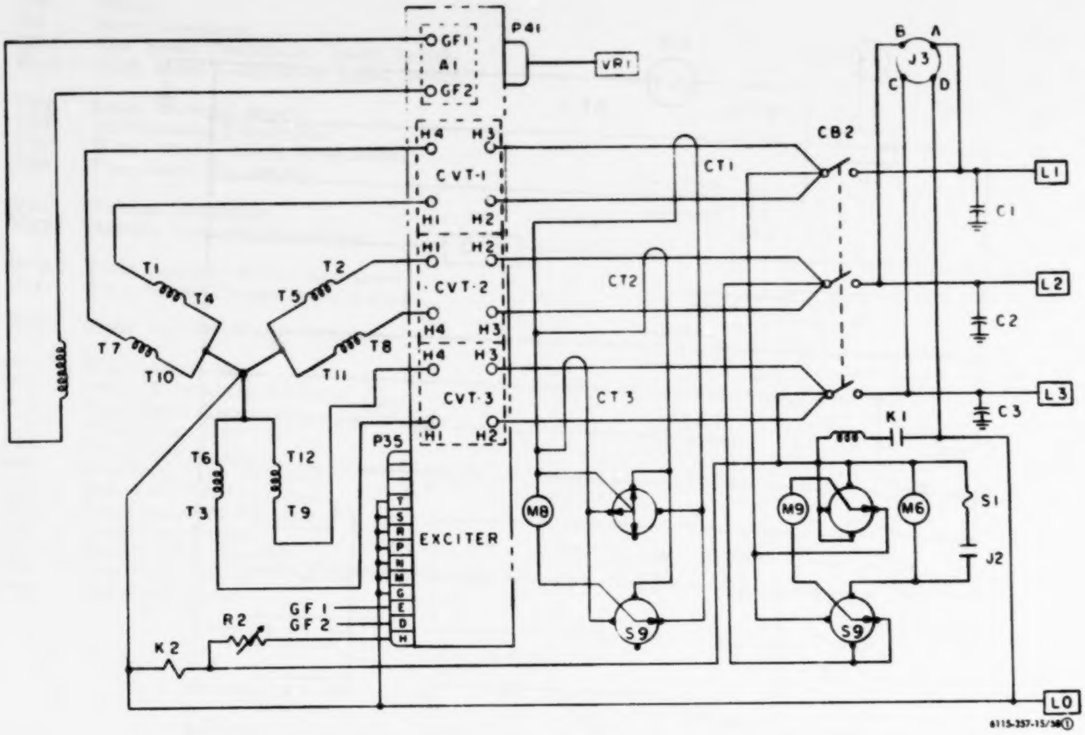
A
B CB2
C
CT1
CT2
CT3
P1
J1
CONTROL BOX
P14
WATER TEMPERATURE SWITCH
P13
OIL PRESSURE SWITCH
P25
BATTERY REGULATOR VR2
P38
OVERSPEED SWITCH
P39
DAY TANK FLOAT
P36
DAY TANK SOLENOID
P42
WATER SEPARATOR
P35
EXCITER
P41
VOLTAGE REGULATOR
P20
WATER SEPARATOR SOLENOID
6115-357-15/56

Figure 56. Wiring harness.

Figure 57. Wiring diagram.
Located in back of manual.


GF1
A1
GF2
P41
VR1
H4
H3
CVT-1
H1
H2
H1
H2
CVT-2
H4
H3
H4
H3
CVT-3
H1
H2
T1
T4
T2
T5
T7
T10
T8
T11
T6
T3
T12
T9
P35
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S
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EXCITER
GF 1
GF 2
R2
K2
CT1
CT2
CT3
CB2
B
A
J3
C
D
L1
C1
L2
C2
L3
C3
K1
M8
M9
M6
S1
J2
S9
S9
L0
6115-357-15/58①

BT1	Battery	**K2**	Overvoltage Relay
BT2	Battery	**K3**	Crank Relay
C1	Capacitor	**K5**	Field Flash Relay
C2	Capacitor	**K8**	Fuel Level Relay
C3	Capacitor	**L10**	Start Solenoid
CB1	D.C. Circuit Breaker	**L20**	Water Separator Solenoid
CB2	Main A.C. Circuit Breaker	**L30**	Day Tank Solenoid
CR1	Diode-Reverse Polarity	**L4**	Ether Primer
CT1	Instrument Current Transformer	**L5**	Fuel Solenoid
CT2	Instrument Current Transformer	**L0**	Load Terminal
CT3	Instrument Current Transformer	**L1**	Load Terminal
CR2	Diode	**L2**	Load Terminal
CR3	Diode	**L3**	Load Terminal
DS1	Panel Lights	**M1**	Oil Pressure Gage
DS2	Panel Lights	**M2**	Water Temperature Gage
DS3	Panel Lights	**M3**	Fuel Level Gage
EXC	Static Exciter	**M4**	Battery Ammeter
FL1	Float Switch	**M5**	Elapsed Time Meter
FL2	Float Switch	**M6**	Frequency Meter
FP1	Fuel Pumps	**M8**	Ammeter
FP2	Fuel Pumps	**M9**	Voltmeter
FS1	Fuse 15A	**MTR-1**	Starter Motor
G1	A.C. Generator	**OP**	Low Oil Pressure Switch
G2	Battery Charging Generator	**R2**	Voltage Adjusting Rheostat
J1	Receptacle—Control Box	**S1**	Engine Primer Switch
J2	Receptacle—Conv.	**S2**	Stop-Run-Start Switch
J3	Power Output Receptacle	**S4**	Panel Lite Switch
K1	Run Relay	**S7**	Momentary Contact, Emergency Switch
		S7	Volt-Amp Transfer Switch

Figure 58 ① *Schematic diagram 15 K.W. generator set.*

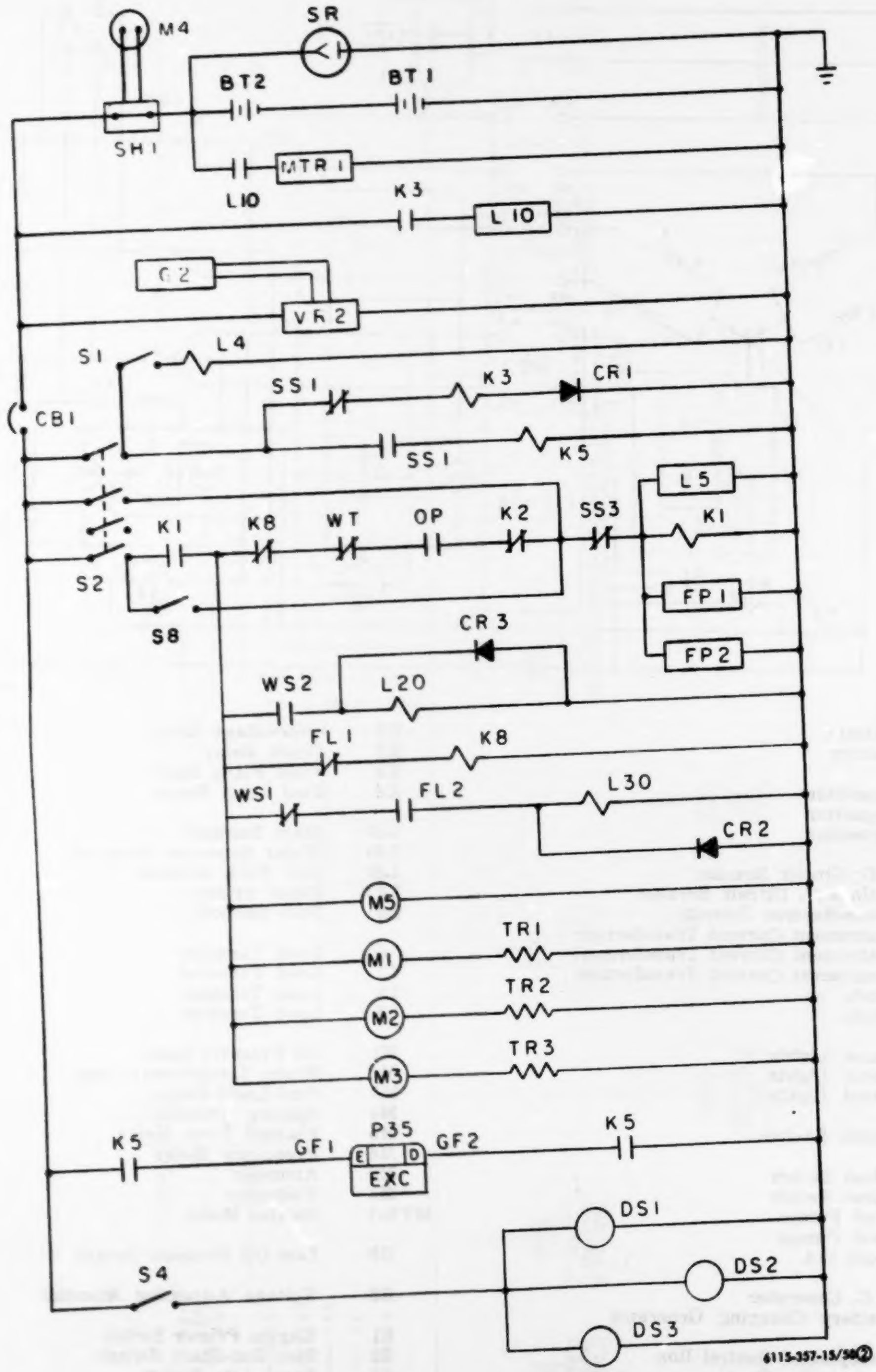
M4
SR
BT2
BT1
SH1
MTR 1
L10
K3
L 10
G2
VR2
S1
L4
SS1
K3
CR1
CB1
SS1
K5
L5
K1
K8
WT
OP
K2
SS3
K1
S2
S8
FP1
FP2
CR3
WS2
L20
FL1
K8
WS1
FL2
L30
CR2
M5
TR1
M1
TR2
M2
TR3
M3
K5
P35
GF1
GF2
E
D
EXC
K5
DS1
S4
DS2
DS3
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Figure 58 ②—Continued.

SH1	**Shunt**
SR	**Slave receptacle**
SS-1	**Low Speed Contacts on Speed Switch**
SS-3	**High Speed Contacts on Speed Switch**
TB2	**Load Terminal Board**
TR1	**Oil Pressure Transmitter**
TR2	**Water Temperature Transmitter**
TR3	**Fuel Level Transmitter**
VR1	**Voltage Regulator**
VR2	**Battery Charging Regulator**
WS1	**Float Switch—Water Separator**
WT	**High Water Temperature Switch**
WS2	**Float Switch—Water Separator**
P1	**Plug-Control Box**
P13	**Plug-Oil Pressure Switch**
P14	**Plug-Water Temperature Switch**
P20	**Plug-Water Solenoid**
P35	**Plug Exciter Input**
P36	**Plug-Day Tank Solenoid**
P37	**Plug-Fuel Pumps**
P38	**Plug-Overspeed Switch**
P39	**Plug-Float Switch**
P41	**Plug-Voltage Regulator**
P42	**Plug-Water Separator Switch**
P44	**Plug-Fuel Pump**

24. Fits and Tolerances

Manufacturer's tolerances, desired clearances, minimum and maximum allowable wear and clearances on engine components are listed in Table 1.

Fits and Tolerances

Engine components		Mfg's. tolerances		Desired clearance		Maximum allowable wear	Maximum allowable clearance
		Minimum	Maximum	Minimum	Maximum		
A. CYLINDER BLOCK							
1	Cylinder bore dia. 4" bore	3.9990	4.0010			0.0050	
2	Cylinder bore out of round		0.0005			0.0030	
3	Cylinder bore taper		0.0005			0.0020	
4	Main brg. bore—less brgs.	3.0665	3.0670				
5	Camshaft brg. bore—less brgs.	2.1870	2.1880				
6	Oil pump bore	2.0000	2.0005				
7	Valve tappet bore	0.7494	0.7500				
8	Main brg. cap bolt torque ft. lbs.	78	82	80			
B. CRANKSHAFT							
1	Main brg. journal dia.	2.8734	2.8744			0.0030	
2	Main brg. journal out of round		0.0003			0.0020	
3	Main brg. journal taper		0.0003			0.0015	
4	Main brg. run-out of center		0.0020			0.0030	
5	Conn. rod journal dia.	2.3730	2.3740			0.0020	
6	Conn. rod journal out of round		0.0003			0.0020	
7	Conn. rod journal taper		0.0003			0.0015	
8	Fillet radii	0.1400	0.1700				
9	Crankcase main brg. clearance			0.0009	0.0034		0.0070
10	Crankshaft thrust clearance			0.0050	0.0100		0.0150
11	Seal surface dia.—rear	4.3100	4.3150			0.0150	
12	Seal surface dia.—front	1.8740	1.8750			0.0150	
C. CONNECTING ROD							
1	Length—c/l to c/l	7.9980	8.0020				
2	Bearing bore—less bearings	2.5260	2.5270				
3	Br. to crankshaft clearance			0.0010	0.0030		0.0050
4	Conn. rod side clearance			0.0050	0.0120		0.0200
5	Piston pin bushing bore—less bushing	1.4370	1.4380				
6	Piston pin bushing bore	1.2503	1.2508			0.0015	
7	Cap bolt torque ft. lbs.	68	72	70			
D. CAMSHAFT							
1	Bearing journal dia.—all	2.0530	2.0540			0.0020	
2	Lobe diameter—base to tip	1.7200	1.7250			0.0100	
3	Journal run-out in vee blocks		0.0010			0.0040	
4	Bearing clearance			0.0015	0.0035		0.0060
5	End thrust			0.0015	0.0055		0.0120
6	Back lash camshaft to crank gear			0.0010	0.0030		
7	Gear retaining nut torque ft. lbs.	125	135	130			
E. PISTON			(With newly honed bores and new pistons)				
1	Clearance in cyl. bore—all	5 lb.	8 lb.	Plll on 1/2 x 0.0050 ribbon			
2	Piston pin bore	1.2500	1.2502			0.0010	
3	Width of ring groove—top—Keystone	1/8 nom.					
4	Width of ring groove—2nd & 3rd comp.	0.0975	0.0990			0.0050	
5	Width of ring groove—top—oil contr.	0.1880	0.1895			0.0050	
6	Width of ring groove—lower oil control	0.1880	0.1890			0.0050	

Fits and Tolerances—Continued

Engine components	Mfg's. tolerances		Desired clearance		Maximum allowable wear	Maximum allowable clearance
	Minimum	Maximum	Minimum	Maximum		
F. PISTON PIN						
1 Length 4″ dia. piston	3.3600	3.3650				
2 Diameter	1.2498	1.2499			0.0020	
3 Clearance in piston			0.0000	0.0005		0.0020
4 Clearance in connecting rod			0.0005	0.0012		0.0050
G. PISTON RING						
1 Clearance in groove—top	Keystone	taper				
2 Clearance in groove—2nd & 3rd comp.	0.0040	0.0060				0.0080
3 Clearance in groove—oil control	0.0015	0.0030				0.0080
4 Gap	0.0100	0.0200				0.0400
H. Valve, INTAKE						
1 Head diameter	1.6825	1.6925				
2 Stem diameter	0.3735	0.3735			0.0025	
3 Stem to guide clearance			0.0005	0.0025		0.0050
4 Stem to rocker arm clearance—hot			0.0150			
5 Seat diameter in head	1.6470	1.6530				
6 Seat width in head		7/64			1/8	
7 Top of valve recessed below cyl. hd. deck	0.0210					
8 Valve seat angle	30°					
I. VALVE, EXHAUST						
1 Head diameter	1.4950	1.5050				
2 Stem diameter	0.3740	0.3750			0.0025	
3 Stem to guide clearance			0.0015	0.0035		0.0060
4 Stem to rocker arm clearance—hot			0.0150			
5 Seat diameter in head	1.4510	1.4560				
6 Seat width in head		7/64			1/8	
7 Top of valve recessed below cyl. hd. deck	0.0210					
8 Valve heat angle	45°					
J. VALVE GUIDE						
1 Length	2.0325	2.9524				
2 Outside diameter	0.6265	0.6270				
3 Bore diameter—intake—ream	0.3740	0.3750			0.0030	
4 Bore diameter—exhaust—ream	0.3750	0.3760			0.0030	
5 Depth below cyl. head deck—all	1.3700	1.3800				
K. TAPPET, VALVE LIFTER (PUSH ROD)						
1 Body diameter	0.7485	0.7490			0.0030	
2 Overall length	2.2450	2.2550				
3 Clearance in bore (block)			0.0005	0.0015		0.0050
L. VALVE SPRINGS—INTAKE & EXHAUST						
1 Free length	1.7960	1.8360				
2 Total coils	6-1/4					
3 Diameter wire	0.1770					
4 Outside diameter	1.2920	1.3020				
5 Test load at 1.4920 inches lbs.	72	82				
6 Test load at 1.0820 inches lbs.	163	180				
L. a Valve Spring—intake & exhaust						
1 Free length	1.8630	1.9030				
2 Total coils	7-1/2					
3 Diameter wire	.1420					
4 Outside diameter	1.2300	1.2500				
5 Test load at 1.5225 inches lbs.	38	45				
6 Test load at 1.1725 inches lbs.	80	86				

Fits and Tolerances—Continued

Engine components	Mfg's. tolerances		Desired clearance		Maximum allowable wear	Maximum allowable allowable
	Minimum	Maximum	Minimum	Maximum		
M. OIL PUMP						
BODY:						
1 Shaft bore diameter—main	0.6255	0.6265			0.0030	
2 Shaft bore diameter—idler	0.6255	0.6265			0.0030	
3 Pump gear bore diameter	1.5005	1.5015			0.0050	
4 Pump gear bore depth	1.5640	1.5650			0.0040	
SHAFTS:						
5 Length—main	9.2400	9.2500				
6 Length—idler	2.7450	2.7550				
7 Diameter—main	0.6240	0.6245			0.0020	
8 Diameter—idler	0.6240	0.6245			0.0020	
9 Shaft clearance in body			0.0010	0.0025	0.0030	0.0060
GEARS:						
10 Outside diameter—both	1.4975	1.4985			0.0020	
11 Length—both	1.5610	1.5620				
12 Clearance in body bore			0.0020	0.0040		0.0070
13 End clearance to body			0.0020	0.0040		0.0080
14 Blacklash, drive gear to camshaft			0.0060	0.0120		0.0200
N. FLYWHEEL						
1 Clutch face run out at 6 in. rad.		0.0080				
2 Pilot bore eccentricity		0.0050				
O. FLYWHEEL HOUSING						
1 Clutch attaching face deviation		0.0080				
2 Clutch housing bore eccentricity		0.0050				
Q. ROCKER ARM MECHANISM						
1 Rocker shaft length—4 cyl.	19.4900	19.5100				
2 Rocker shaft diameter	0.8590	0.8600			0.0030	
3 Rocker arm bore diameter	0.8625	0.8635			0.0030	
4 Rocker arm clearance on shaft			0.0025	0.0045		0.0120
5 Tappet adjusting screw torque ft. lbs.	3	10				
P. TORQUE VALVES—MISC. FT. LBS.						
1 Cyl. head nuts 5/8" solid stud	170	180	175			
2 Cyl. head nuts 5/8" hollow stud	145	155	150			
3 Cyl. Head nuts 9/16" studs	145	155	150			
4 Flywheel bolt	77	83	80			
5 Manifold—intake & exhaust	30	40	35			
6 Fuel nozzle attaching nut	18	22	20			
7 All other bolts and nuts to be securely but not exceedingly tightened.						

SECTION VII

DEMOLITION OF THE GENERATOR SET TO PREVENT ENEMY USE

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25. General

When capture or abandonment of the electric generator set to an enemy is imminent, the responsible unit commander must make the decision either to destroy the equipment or to render it inoperative. Based on this decision, orders are issued which cover the desired extent of destruction. Whatever method of demolition is employed, it is essential to destroy the same vital parts of the electric generator set and all corresponding repair parts.

26. Demolition by Mechanical Means

The electric generator set can be demolished by mechanical means by use of sledge hammers, pick axes, crow bars or other heavy tools which may be available together with those tools normally stored on the generator set and destroy the following:

a. The engine fuel pump, governor, and voltage regulator.

b. The engine shrouds, cylinder heads and manifolds.

c. The generator instrument panel, control box, circuit breaker, batteries and the generator and static exciter assembly.

27. Demolition by Explosives or Weapons Fire

a. Explosives. Place charges as indicated in figure 59 as situation permits and detonate them simultaneously choosing best firing method that will secure best results.

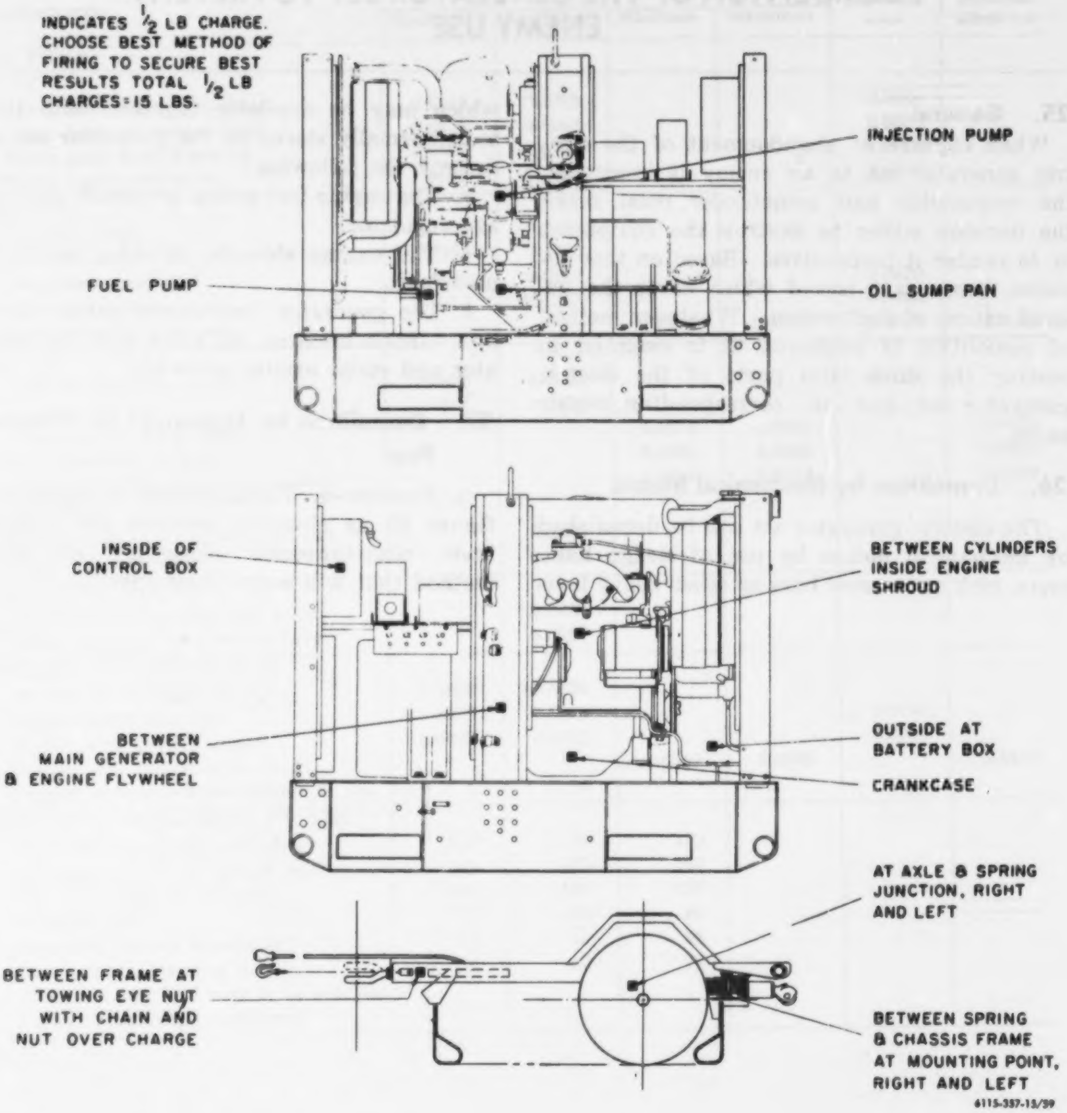
INDICATES ½ LB CHARGE. CHOOSE BEST METHOD OF FIRING TO SECURE BEST RESULTS TOTAL ½ LB CHARGES=15 LBS.
INJECTION PUMP
FUEL PUMP
OIL SUMP PAN
INSIDE OF CONTROL BOX
BETWEEN CYLINDERS INSIDE ENGINE SHROUD
BETWEEN MAIN GENERATOR & ENGINE FLYWHEEL
OUTSIDE AT BATTERY BOX
CRANKCASE
AT AXLE & SPRING JUNCTION, RIGHT AND LEFT
BETWEEN FRAME AT TOWING EYE NUT WITH CHAIN AND NUT OVER CHARGE
BETWEEN SPRING & CHASSIS FRAME AT MOUNTING POINT, RIGHT AND LEFT
6115-357-15/59

Figure 59. Placement of demolition charges.

b. Weapons Fire. Fire on the engine and electric generator set with the heaviest practicable weapon available.

28. Other Demolition Methods

If the situation prohibits employing either of the preferred methods, use the following singly or in a combination.

a. Demolition by Scattering and Concealment. Remove all easily accessible vital parts such as the fuel pump, governor, generator and voltage regulator and scatter them through dense foliage, bury them in dirt or sand, or throw them in a lake or stream, well or any other body of water.

b. Demolition by Burning. Pack rags, clothing or canvas around the engine and generator and rectifier assembly or other vital parts. Saturate this packing with gasoline, oil or diesel fuel and ignite.

c. Demolition by Submersion. Totally submerge the electric generator set in a body of water to provide some water damage and to conceal the unit. Salt water will do the greatest damage to parts.

d. Demolition by Misuse. Perform the following steps to make the electric generator set inoperative.

(1) Drain the radiator and engine crankcase. Pour sand in the engine crankcase.

(2) Disconnect the radiator fan and run the engine at full throttle.

Note. The above steps are minimum requirements for this method.

29. Training

All operators should receive thorough training in the destruction of the engine. Simulated destruction, using all the methods listed in paragraphs 24 through 26, should be included in the operators training program. It must be emphasized in training that demolition operations are usually necessitated by critical situations, when the time available for destruction is limited. For this reason, it is necessary that operators be thoroughly familiar with all methods of destruction and be able to carry out demolition instructions without reference to this or any other manual.

SECTION VIII

SHIPMENT AND LIMITED STORAGE

30. Preparation of Equipment for Shipment

a. General. When preparing the generator set for shipment, an inspection must be made to see that all components are in a good state of repair, and can be put into immediate operation upon receipt of the equipment.

b. Preparation. Prepare the generator set for shipment in the following manner:

(1) Clean all exterior metal surfaces with an approved cleaning solvent and dry thoroughly.

(2) Disconnect battery cables.

(3) Close all generator set doors to prevent entrance of water and other foreign matter.

(4) Tag all items requiring special attention before operation of the generator set upon receipt of shipment.

(5) Place all on equipment tools and accessories in the tool box.

(6) Drain the fuel tank, oil, and coolant.

(7) If the shipping point is close by, the generator set can be towed to the destination and need not be crated.

(8) If the unit is to be crated construct a suitable crate in accordance with the current packing procedures.

31. Loading of Equipment for Shipment

a. If the unit is crated, attach a sling to the lifting points marked on the crate. Lift the crated generator set on the carrier with a suitable lifting device.

b. Spike wedge-shaped blocking at each end of the crated unit to secure the generator set to the carrier bed. Tie down the crated unit to the carrier with straps in at least two places.

c. If the generator set is uncrated, use a suitable lifting sling (sec. 11) and load the unit on the carrier. Secure the generator set to the carrier bed.

32. Preparation of Equipment for Storage

a. Inspection. Make a complete inspection of the generator set to determine its condition. Drain oil, fuel, and water from unit. Disconnect battery.

b. Cleaning and Painting.

(1) Wipe off and clean all parts of the generator set that can be reached without disassembly.

(2) Remove any accumulated water, oil, or grease from the generator set.

(3) Remove all rust or corrosion and paint all parts of which the paint has been damaged or removed.

c. *Weather Proofing.* Coat all exposed, unpainted metal parts with a temporary preservative such as light engine oil or grease.

33. Inspection and Maintenance of Equipment in Storage

a. Inspection. Inspect the generator set every 10 days while in storage. Inspect the unit for pilferage and for physical damage caused by rust resulting from accumulated moisture.

b. Maintenance. Service the generator set as described in Section II.

APPENDIX A
REFERENCES

1. Lubrication

LO 5-6115-357-12	Lubrication Order. Generator Set, Diesel Engine: Wheel Mounted Liquid Cooled, 15 KW 400 Hertz, AC, 3 Phase, 4 Wire, 120/208 V; Non-Winterized, Special Purpose. FSN 6115-089-5099

2. Maintenance

TM 5-6115-357-20P	Organizational Maintenance Repair Parts and Special Tools List, Generator Set, Diesel Engine: Wheel Mounted Liquid Cooled, 15 KW 400 Hertz, AC, 3 Phase 4 Wire, 120/208 V; Non-Winterized. Special Purpose, FSN 6115-089-5099
TM 5-6115-357-35P	DS, GS, and Depot Maintenance Repair Parts and Special Tools List. Generator Set, Diesel Engine: Wheel Mounted Liquid Cooled, 15 KW 400 Hertz, AC, 3 Phase 4 Wire, 120/208 V; Non-Winterized, Special Purpose, FSN 6115-089-5099.

3. Supply Publications

C9100-IL	Petroleum, Petroleum-Base Products, and Related Material.

APPENDIX B
MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

1. General

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance operations on the identified end item or component. The implementation of the maintenance tasks upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance operation as referenced from Section II.

d. Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

2. Explanation of Columns in Section II

a. Functional Group Number. The functional group is a numerical group set up on a functional basis. The applicable functional grouping indexes (obtained from TB 750-93-1, Functional Grouping Codes) are listed on the MAC in the appropriate numerical sequence. These indexes are normally set up in accordance with their function and proximity to each other.

b. Component Assembly Nomenclature. This column contains a brief description of the components of each functional group.

c. Maintenance Functions. Column 3. This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these functions. The symbol designations for the various maintenance categories are as follows:

C—Operator or crew
O—Organizational maintenance
F—Direct support maintenance
H—General support maintenance
D—Depot maintenance

The maintenance functions are defined as follows:

A—INSPECT: To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

B—TEST: To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

C—SERVICE: To clean, to preserve, to charge, to paint, and to add fuel, lubricants, cooling agents, and air.

D—ADJUST: To rectify to the extent necessary to bring into proper operating range.

E—ALINE: To adjust specified variable elements of an item to bring to optimum performance.

F—CALIBRATE: To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

G—INSTALL: To set up for use in an operational environment such as an emplacement, site, or vehicle.

H—REPLACE: To replace unserviceable items with serviceable assemblies, subassemblies, or parts.

I—REPAIR: To restore an item to serviceable condition. This includes, but is not limited to, inspection, cleaning, preserving, adjusting, replacing, welding, riveting, and strengthening.

J—OVERHAUL: To restore an item to a completely serviceable condition as prescribed by maintenance serviceability standards using the Inspect and Repair Only as Necessary (IROAN) technique.

K—REBUILD: To restore an item to a standard as nearly as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements (items) using original manufacturing tolerances and specifications, and subsequent reassembly of the item.

d. Reference Note. This column, subdivided into column L and M is provided for referencing the Special Tool and Test Equipment Requirements (sec. III) and Remarks (Sec. IV) that may be associated with maintenance functions (Sec. II).

3. Explanation of Columns in Section III

a. Reference Code. This column consists of a number and a letter separated by a dash. The number references the tools and equipment requirements column on the Maintenance Assignment. The letter represents the specific maintenance function the item is to be used with. The letter is representative of columns A through K on the Maintenance Assignment.

b. Maintenance Category. This column shows the lowest level of maintenance authorized to use the special tool or test equipment.

c. Nomenclature. This column lists the name or identification of the tool or test equipment.

d. Tool Number. This column lists the ma ufacturer's code and part number, or Federal stock number of tools and test equipment.

4. Explanation of Columns in Section IV

a. Reference Code. This column consists of two letters separated by a dash, both of which are references to Section II. The first letter references column M and the second letter references a maintenance operation, columns A through K.

b. Remarks. This column lists information pertinent to the maintenance operation being performed, as indicated on the Maintenance Assignment Section II.

Section II. MAINTENANCE ASSIGNMENT

Functional group number	Component assembly nomenclature	Maintenance functions											Note reference	
		A	B	C	D	E	F	G	H	I	J	K	L	M
		Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
01	ENGINE													
0100	Engine Assembly	C	F	C	....	....	....	....	F	F	H	....	....	A
0101	Crankcase, Block, Cylinder Head:													
	Block, engine	H	....	....	....	....	....	....	H	H	H			
	Cylinder head	F	....	....	....	....	....	....	F	F	....	....	....	B
0102	Crankshaft:													
	Bearings, main	H	....	....	....	....	....	....	H	....	....	....	....	C
	Crankshaft	H	....	....	....	....	....	....	H	D	....	....	....	C
	Pulley grooved	....	....	....	....	....	....	....	F					
	Seal, oil	H	....	....	....	....	....	....	H					
0103	Flywheel Assembly:													
	Flywheel	O	....	....	....	....	....	....	F					
	Ring gear	O	....	....	....	....	....	....	H					
0104	Pistons, Connecting Rods:													
	Bearing, sleeve	H	....	....	....	....	....	....	H	....	....	....	....	C
	Connecting rod assembly	H	....	....	....	H	....	....	H	H				
	Pin, piston	H	....	....	....	....	....	....	H	H	....	....	....	C
	Piston assembly	H	....	....	....	....	....	....	H	....	....	....	....	C
	Ring, piston	H	....	....	....	....	....	....	H	....	....	....	....	D
0105	Valves, Camshafts and Timing System:													
	Bearings, camshaft	H	....	....	....	....	....	....	H	....	....	....	....	C
	Camshaft assembly	H	....	....	....	....	....	....	H	....	....	....	....	C
	Gears, timing	H	....	....	....	....	....	....	H					
	Guide, valve	F	....	....	....	....	....	....	F	....	....	....	....	C
	Housing, gear	....	....	....	....	....	....	....	H					
	Lifter, valve	H	....	....	....	....	....	....	H	....	....	....	....	C
	Rocker arm assembly	F	....	....	....	....	....	....	F	....	....	....	....	C
	Rod assembly, push	F	....	....	....	....	....	....	F	....	....	....	....	E
	Seat, valve spring	....	....	....	....	....	....	....	F					
	Shaft assembly rocker arm	F	....	....	....	....	....	....	F	F	....	....	....	C
	Spring, valve	....	F	....	....	....	....	....	F					
	Support, rocker arm shaft	....	....	....	....	....	....	....	F					
	Valve, poppet	F	....	....	....	....	....	....	F	F	....	....	....	E
	Cover, rocker arm	....	....	....	....	....	....	....	O					

Functional group number	Component assembly nomenclature	Maintenance functions											Note reference	
		A	B	C	D	E	F	G	H	I	J	K	L	M
		Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
0106	Engine Lubrication System:													
	Breather assembly			C					O					
	Filter, oil								O					
	Gage, liquid level	C							O					
	Hose assembly, oil								O					
	Line assembly, oil								O					
	Pan, oil								F	F				
	Pump assembly, oil								F	F				
	Strainer, oil pump			F					F					
	Tube, oil filler								O					
0107	Engine Starting System:													
	Crank, hand								O					
0108	Manifolds:													
	Manifold	O							O					
03	FUEL SYSTEM													
0301	Fuel Injector:													
	Injector assembly	O		F					O	F				
	Sleeve, injector	F							F					
0302	Fuel Pumps:													
	Pump, fuel injection		F		F		H		O	H	H			
	Pump, fuel transfer		O						O	O				
0304	Air Cleaner:													
	Air cleaner assembly			C					O					
0306	Tanks, Lines, Fittings:													
	Gage, fuel tank	C	O						O					
	Hose, fuel	O							O					
	Line assembly, fuel								O					
	Nozzle, fuel			O					F					
	Strainer, fuel tank			C					O	O				
	Tank, fuel (day tank)		O	C					O	O				
	Tank, fuel supply		F	C					F	F				
	Valve, fuel selector								O					
0309	Fuel Filters:													
	Filter assembly, fuel			C					O					
0311	Engine Starting Aids:													
	Line assembly, primer								O					
	Primer, pressure (ether)			C					O					

Functional group number	Component assembly nomenclature	Maintenance functions											Note reference	
		A	B	C	D	E	F	G	H	I	J	K	L	M
		Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
04	EXHAUST SYSTEM													
0401	Muffler and Pipes:													
	Muffler, exhaust	C	....	....	....	....	....	....	O					
	Pipe, exhaust	C	....	....	....	....	....	....	O					
	Rain cap, exhaust	C	....	....	....	....	....	....	O					
05	COOLING SYSTEM													
0501	Radiator:													
	Control, Shutter	....	....	C	O	....	....	....	O	O				
	Grille, radiator													
	Radiator assembly	O	F	C	....	....	....	....	O	F				
	Shutter assembly	....	....	....	....	....	....	....	O	O				
	Thermostat, shutter control	....	O	....	....	....	....	....	O					
0502	Shrouds:													
	Shroud	....	....	....	....	....	....	....	O					
0503	Water Manifolds, Headers, Thermostat and Housing Gaskets:													
	Hose, radiator	O	....	....	....	....	....	....	O					
	Housing, thermostat	....	....	....	....	....	....	....	O					
	Thermostat, engine	....	O	....	....	....	....	....	O					
0504	Water:													
	Pump	O	....	....	....	....	....	....	O	F				
0505	Fan Assembly:													
	Belt, drive	O	....	....	O	....	....	....	O					
	Fan assembly	O	....	....	....	....	....	....	O					
06	ELECTRICAL SYSTEM (ENGINE AND VEHICULAR)													
0601	Generator:													
	Generator	O	F	....	....	....	....	....	O	F				
	Brush, generator	O	....	....	....	....	....	....	O					
0602	Generator Regulator:													
	Regulator, generator	....	F	....	....	F	....	....	O					
0603	Starting Motor:													
	Starter, electrical	O	O	O	....	....	....	....	O	F				
	Brushes, contact, solenoid	O	....	....	....	....	....	....	O					
0606	Engine Safety Controls:													
	Governor, overspeed	....	F	....	F	....	....	....	O					

Functional group number	Component assembly nomenclature	Maintenance functions											Note reference	
		A	B	C	D	E	F	G	H	I	J	K	L	M
		Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
0607	**Instrument or Engine Control Panel:**													
	Ammeter	C	O	....	....	....	....	....	O					
	Circuit breaker	....	O	....	....	....	....	....	O					
	Gages, electrical	C	O	....	....	....	....	....	O					
	Hourmeter, electrical	C	O	....	....	....	....	....	O					
	Lights, panel	....	O	....	....	....	....	....	O					
	Receptacle, outlet	....	O	....	....	....	....	....	O					
	Switches, stop-start	....	O	....	....	....	....	....	O					
0608	**Miscellaneous Items:**													
	Cable, slave receptacle	....	O	....	....	....	....	....	O					
	Receptacle, slave	....	O	....	....	....	....	....	O					
	Switch, day tank	....	O	....	....	....	....	....	O					
0609	**Lights:**													
	Lamp, incandescent	....	....	....	....	....	....	....	O					
	Light	....	....	....	....	....	....	....	O					
0610	**Sending Units and Warning Switches:**													
	Sending unit, pressure oil	....	O	....	....	....	....	....	O					
	Sending unit, temperature	....	O	....	....	....	....	....	O					
0612	**Batteries, Storage:**													
	Battery, storage	....	O	C	....	....	....	....	O					
	Cable, battery	....	....	....	....	....	....	....	O	O				
0613	**Hull or Chassis Wiring Harness:**													
	Harness, wiring, engine	....	O	....	....	....	....	....	F	O				
0615	**Radio Interference Suppression:**													
	Strap, bonding	....	O	....	....	....	....	....	O					
12	**BRAKES**													
1201	**Hand Brakes:**													
	Shoe assembly	....	....	....	....	....	....	....	O	F				
	Backing plate	....	....	....	....	....	....	....	O					
	Lever and cable	....	....	C	....	....	....	....	O					
13	**WHEELS AND TRACKS**													
1311	**Wheel Assembly:**													
	Wheel assembly	C	....	....	....	....	....	....	O	O				
	Bearings	....	....	O	....	....	....	....	O					
1313	**Tires, Tubes:**													
	Tires	....	....	C	....	....	....	....	O					
	Tubes	....	....	....	....	....	....	....	O	O				

Functional group number	Component assembly nomenclature	Maintenance functions											Note reference	
		A	B	C	D	E	F	G	H	I	J	K	L	M
		Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
15	FRAME, TOWING ATTACHMENTS AND DRAW-BARS													
1501	Frame Assembly:													
	Base, skid								F	O				
	Frame, trailer								F					
1503	Pintles and Towing Attachments:													
	Coupler								O	O				
	Pintle assembly								O	O				
1507	Landing Gear, Leveling Jacks:													
	Leg assembly	C							O	O				
1601	Springs:													
	Link, spring								O					
	Shackle assembly								O					
	Spring assembly	C		C					O					
	Bumper, axle								O					
18	BODY, CAB, HOOD, AND HULL													
1801	Body, Cab, Hood and Hull Assemblies:													
	Cover, housing								O	O				
	Doors, access								O	O				
	Frame, housing								O	O				
	Panel, housing								O	O				
	Shroud, generator								O	O				
	Support, housing								O	O				
	Splash guard, trailer								O					
22	BODY CHASSIS OR HULL AND ACCESSORY ITEMS													
2202	Accessory Items:													
	Hose assembly, auxiliary	C							C	F				
2210	Data Plates and Instruction Holders:													
	Plates, data	C							O					
	Plates, identification	C							F					
40	ELECTRIC MOTORS AND GENERATORS													
4000	Generator Assembly		F						F	H	D			
4001	Rotor Assemblies		H						H	H	D			G
4002	Stator Assemblies		H						H	H	D			H
4003	Brush Holders:													
	Brush, electrical contact	O							O					

Functional group number	Component assembly nomenclature	Maintenance functions A Inspect	B Test	C Service	D Adjust	E Aline	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	Note reference L Tools and equipment	M Remarks
	Holder, brush	....	F	....	....	....	....	....	F					
	Spring brush	....	F	....	F	....	....	....	F					
4004	Ventilating System:													
	Fan, cooling	F	....	....	....	....	....	....	F					
4005	Frame Support and Housings:													
	Bearings, rotor shaft	H	....	....	....	....	....	....	H					
	Housing, bearing	H	....	....	....	....	....	....	H					
	Retainer, bearing	H	....	....	....	....	....	....	H					
4007	Drive Components:													
	Disk, drive coupling	H	....	....	....	....	....	....	H					
4009	Control Panels, Housing Cubicles:													
	Box assembly, control	C	F	....	....	....	....	....	F	O	H			
	Harness, wiring	C	O	....	....	....	....	....	F	O				
	Lights, panel	C	....	....	....	....	....	....	O	O				
	Meters, electrical	C	....	....	....	....	....	....	O					
4011	Circuit Breakers, Fuse and Fuse Holders:													
	Breaker, circuit	C	F	....	....	....	....	....	F					
	Fuse, safety	C	....	....	....	....	....	....	C					
	Holder, fuse	C	....	....	....	....	....	....	O					
4012	Switches:													
	Switch, Selector	C	F	....	....	....	....	....	F					
4013	Regulator, Voltage or Current:													
	Regulator assembly voltage	....	F	....	F	....	....	....	F	F	H			
4014	Resistors:													
	Resistor, fixed	....	F	....	....	....	....	....	F					
	Resistor, variable	....	F	....	F	....	....	....	F					
	Rheostat, control	....	F	....	C	....	....	....	O					
4017	Transformers; Rectifiers:													
	Transformers, metering	....	....	....	....	....	....	....	F					
4018	Terminal Blocks, Junction Boxes:													
	Board, terminal (strip)	C	F	....	....	....	....	....	F					
	Panel, load	C	....	....	....	....	....	....	C					
	Panel, reconnection	C	....	....	....	....	....	....	C					
4019	Radio Interference Suppression:													
	Capacitors	....	O	....	....	....	....	....	O					
	Lead, grounding	C	....	....	....	....	....	....	O					
4020	Static Exciter Components	....	F	....	....	....	....	....	F	H				

Section III. SPECIAL TOOL AND SPECIAL TEST EQUIPMENT REQUIREMENTS

Reference code	Maintenance level	Nomenclature	Tool number
	No special tools required.		

Section IV. REMARKS

Reference code	Remarks
A—B	Test includes operational and compression checks.
B—I	Includes refacing as necessary.
C—H	Includes micrometer measurements.
D—H	Includes end and side clearances.
E—H	Includes runout measurement with V block and dial indicator.
F—I	Includes bench test on stand.
G—I	Includes checking located balance.
H—J	Includes stator rewinding.

APPENDIX C
BASIC ISSUE ITEMS LIST AND MAINTENANCE AND OPERATING SUPPLIES

Section I. INTRODUCTION

1. General

Section II lists the accessories, tools, end publications required for maintenance and operation by the operator, initially issued with, or authorized for the Hol-Gar Corporation Model SP-HF-15 Generator Set. Section III lists the maintenance and operating supplies required for initial operation.

2. Explanation of Columns Contained in Section II

a. Source Codes. The information provided in each column is as follows:

(1) *Materiel.* This column is left blank. For identification of agencies assigned supply responsibility for parts, refer to appropriate Federal and Department of Army Supply Catalogs.

(2) *Source.* The selection status and source of supply for each part are indicated by one of the following code symbols:

(a) P—applied to high-mortality repair parts which are stocked in or supplied from the army supply system, and authorized for use at indicated maintenance categories.

(b) M—applied to repair parts which are not procured or stocked but are to be manufactured at indicated maintenance categories.

(c) X2—applied to repair parts which are not stocked. The indicated maintenance category requiring such repair parts will attempt to obtain them through cannibalization; if not obtainable through cannibalization, such repair parts will be requisitioned with supporting justification through normal supply channels.

(3) *Maintenance.* The lowest maintenance level authorized to use, stock, install, or manufacture the part is indicated by the following code symbol:

O—Organizational Maintenance

(4) *Recoverability.* Repair parts and/or tool and equipment items that are recoverable are indicated by one of the following code symbols:

(a) R—Applied to repair parts and assemblies which are economically repairable at direct and general support maintenance activities and normally are furnished by supply on an exchange basis.

(b) T—applied to high-dollar value recoverable repair parts which are subject to special handling and are issued on an exchange basis. Such repair parts normally are repaired or overhauled at depot maintenance facilities.

(c) U—applied to repair parts specifically selected for salvage by reclamation units because of precious metal content, critical materials, high-dollar value reusable castings, castings, and the like.

Note. When no code is shown in the recoverability column the part is considered expendable.

b. Federal Stock Number. When a Federal stock number is available for a part, it will be shown in this column, and will be used for requisitioning purposes.

c. Description.

(1) The item name and a brief description of the part shown.

(2) A five-digit Federal supply code for manufacturers and/or other supply services is shown in parentheses followed by the manufacturer's part number. This number shall be used for requisitioning purposes when no Federal stock number is indicated in the Federal stock number column.

Example: (08645) 86453

d. Unit of Issue. If no abbreviation is shown in this column, the unit of issue is "each."

e. Quantity Authorized. This column lists the quantities of repair parts, accessories, tools, or publications authorized for issue to the equipment operator or crew as required.

f. Quantity Issued with Equipment. This column lists the quantities of repair parts, accessories, tools, or publications that are initially issued with each item of equipment. Those indicated by an asterisk are to be requisitioned through normal supply channels as required.

g. Illustrations. This column is subdivided into two columns which provide the following information:

(1) *Figure number.* Provides the identifying number of the illustration.

(2) *Item number.* Provides the referenced number for the parts shown in the illustration.

3. Explanation of Columns Contained in Section III

a. Item. This column contains numerical sequenced item numbers, assigned to each component application, to facilitate reference.

b. Component Application. This column identifies the component application of each maintenance or operating supply item.

c. Source of Supply. This column is left blank. For identification of agencies assigned supply responsibility for parts, refer to appropriate Federal and Department of Army Supply Catalogs.

d. Federal Stock Number. The Federal stock number will be shown in this column and will be used for requisitioning purposes.

e. Description. The item and a brief description are shown.

f. Quantity Required for Initial Operation. This column lists the quantity of each maintenance or operating supply item required for initial operation of the equipment.

g. Quantity Required for Eight Hours Operation. Quantities listed represent the estimated requirements for an average eight hours of operation.

h. Notes. This column contains informative notes keyed to data appearing in the preceding column.

Section II. BASIC ISSUE ITEMS LIST

1 Source codes				2					Illustration
Materiel	Source	Maintenance	Recoverability	Federal stock number	Description	Unit of issue	Quantity authorized	Quantity issued with equipment	Fig item
					Group 31—Basic Issue Items manufacturer installed.				
					3100—Basic Issue Items, manufacturer or depot installed.				
	P	O		6140-057-2554	Battery, Storage, 12 Volt	EA	2	2	
	P	O		6810-249-9354	Sulphuric Acid, Electrolyte	GAL	4	4	
					Hose, Fuel Aux	EA	1	1	
					Adapter, Fuel Aux	EA	1	1	
				7520-559-9618	Case: Maintenance and Operational Manuals, Cotton Duck, Water Repellant, Mildew Resistant MIL-B-11743-B	EA	1	1	
				7510-889-3494	Binder, Loose Leaf: US Army Equipment Log Book	EA	1	1	
					Department of the Army Operator, Organizational Maintenance Manual TM 5-6115-357-15	EA	1	1	
					Group 32—Basic Issue Items, Troop Installed				
					3200—Basic Issue Items, Troop Installed or Authorized				
	M	O			Ground Rod Assembly Manufactured From:				
	P	O		5975-243-5861	Clamp, Electrical: Ground Rod, 1/2 to 1 in. ID (GE)		1	*	
	P	O		5975-642-8937	Rod, Ground: 9 ft. lg. 5/8 in. Dia, Cone Point Section (GE)		1	*	
	P	O		6145-189-6695	Wire, Electrical: No. 6 AWG (10 ft required)	FT	10	*	

Section III. MAINTENANCE AND OPERATING SUPPLIES

(1) Item	(2) Component application	(3) Federal stock number	(4) Description	(5) Quantity required f/initial operation	(6) Quantity required f/8 hrs operation	(7) Notes
1.	0101 Crankcase (1)		Oil, Lubricating: 5 gal. pails as follows:			1. Includes quantity of oil to fill engine oil system as follows:
		9150-265-9435(2)	OE-30	6 qt.	(3)	
		9150-265-9428(2)	OE-10	6 qt.	(3)	5 qt. Crankcase
		9150-242-7603(2)	OES	6 qt.	(3)	1 qt. Oil Filter
2.	0306 Tank, Fuel		Fuel Oil Diesel: Bulk as follows:			2. See C9100-IL for additional data and requisitioning procedures.
		9140-286-5294(2)	Regular grade DF2	18.6 gal.	(4)	
		9140-286-5286(2)	Winter grade DF1	18.6 gal.	(4)	
		9140-286-5283(2)	Arctic grade DFA	18.6 gal.	(4)	3. See current LO for grade specifications and replenishment intervals.
3.	0501 Radiator		Water: Antifreeze	15 qt.		
			55 gal drums as follows: Antifreeze: Ethylene Glycol			4. Tank capacity.
			Antifreeze: Component Arctic	15 qt.		5. Use fuel as prescribed in item 3.
4.	2207 Heater		Fuel Oil, Diesel(6)		1/5 gal.(6)	
			Regular grade DF2		1/5 gal.(6)	6. Average fuel consumption is 1.5 gal. per hour or continuous operation.
			Winter grade DF1		1/5 gal.(6)	
			Arctic grade DFA			
5.	Engine Starting Aid	2910-646-9727	Cylinder, Ether	1 pt.		

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff.

Official:
KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

USASA (2)
ACSI (1)
DCSLOG (1)
CNGB (1)
TSG (1)
CofEngrs (3)
ACSC-E (1)
Dir of Trans (1)
CofSptS (1)
USAMB (1)
USA Arty Bd (2)
USA Armor Bd (2)
USAIB (2)
USARADBD (2)
USAAESWBD (2)
USAAVNTBD (2)
USCONARC (3)
OS Maj Comd (5) except
  USARJ (1)
USASETAF (2)
USAMC (1)
USACDCEC (10)
USAMECOM (46)
MDW (1)
Armies (2)
Corps (2)
USAC (1)
Div (2)
Engr Bde (1)
USMA (2)
Svc Colleges (2)
Br Svc Sch (2)
Gen Dep (10)
Engr Dep (10)
Army Dep (2) except
  TOAD (3)
EAMTMTS (2)
WAMTMTS (2)
MOTBA (1)
MOTBY (1)
MOTKI (1)
MOTSU (1)
Div Engr (2)
Engr Dist (2)
Engr Cen (5)
Engr FLDMS (2)
Ft Knox FLDMS (10)
AMS (3)
MAAG (1)
JBUSMC (1)
USARMA (1)
Mil Msn (1)
USACOMZEUR (2)
USA Mbl Equip R&D Cen (3)
Fld Comd, DASA (8)
USAREUR Engr Proc Cen (2)
USAREUR Engr Sup Con Agcy (10)
Units org under fol TOE:
  5-48 (2)
  5-237 (5)
  5-262 (5)
  5-267 (1)
  5-278 (5)
  5-279 (2)

NG: None.

USAR: Same as Active Army except allowance is one (1) copy for each unit.

For explanation of abbreviations used, see AR 320-50.

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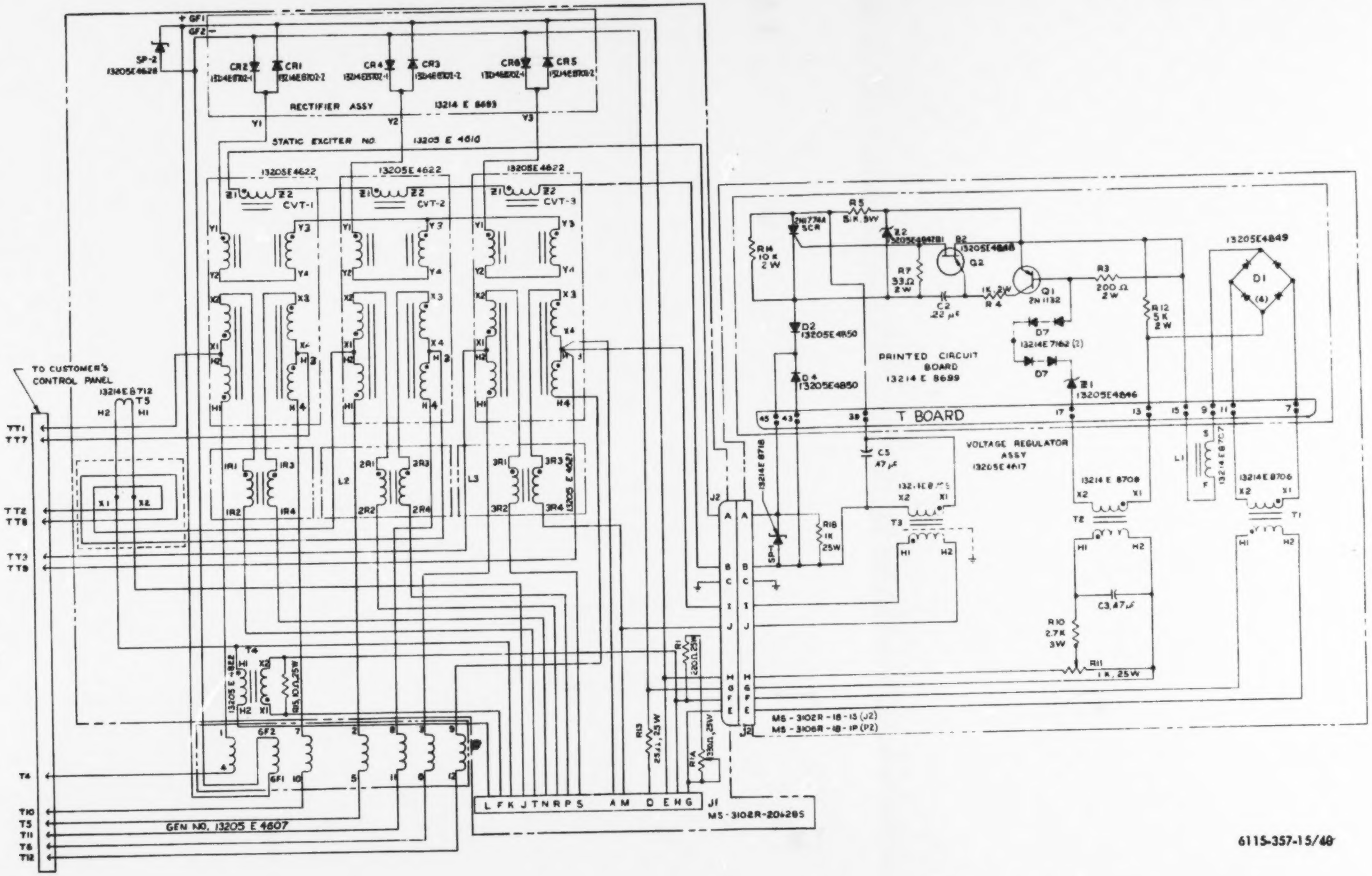
SP-2
13205E4628
+ GF1
GF2 −
CR2
CR1
CR4
CR3
CR6
CR5
RECTIFIER ASSY 13214 E 8693
Y1
Y2
Y3
STATIC EXCITER NO. 13205 E 4610
13205E4622
CVT-1
CVT-2
CVT-3
Z1
Z2
X1
X2
X3
X4
H1
H2
H4
1R1
1R2
1R3
1R4
2R1
2R2
2R3
2R4
3R1
3R2
3R3
3R4
L2
L3
TO CUSTOMER'S CONTROL PANEL
13214E8712
T5
TT1
TT7
TT2
TT8
TT3
TT9
T4
T10
T5
T11
T6
T12
GF1
GF2
GEN NO. 13205 E 4607
L F K J T N R P S A M D E H G J1
MS-3102R-20-29S
R13 25Ω, 25W
R1
R1A
J2
MS-3102R-18-1S (J2)
MS-3106R-18-1P (P2)
R5 5K, 5W
R14 10K 2W
2N1774A SCR
Z2
Q2
R7 33Ω 2W
C2 .22 µF
R4 1K 2W
Q1 2N1132
R3 200 Ω 2W
R12 5K 2W
13205E4849
D1 (4)
D2 13205E4850
D4 13205E4850
D7
13214E7162 (2)
Z1 13205E4846
PRINTED CIRCUIT BOARD 13214 E 8699
T BOARD
45
43
39
17
13
15
9
11
7
C5 .47 µF
VOLTAGE REGULATOR ASSY 13205E4617
L1
13214E8707
13214E8705
13214E8708
13214E8706
T3
T2
T1
R18 1K 25W
SP-1
C3 .47 µF
R10 2.7K 3W
R11 1K, 25W
A B C I J H G F E

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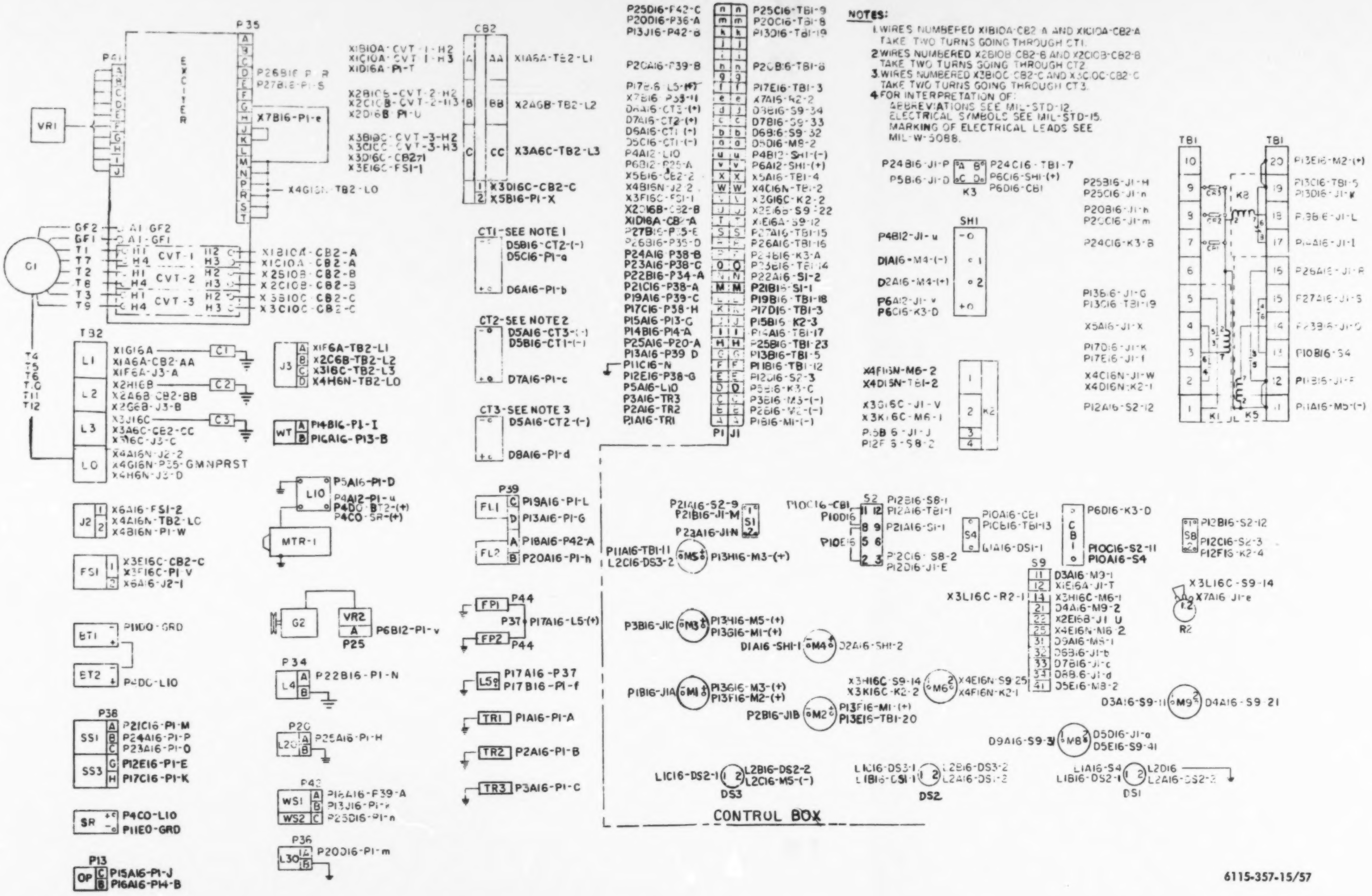
Figure 40. Schematic diagram voltage regulator and exciter.



VR1
P41
EXCITER
P35
G1
CVT-1
CVT-2
CVT-3
CB2
TB2
J3
WT
L10
MTR-1
J2
FS1
G2
VR2
P25
BT1
BT2
P34
L4
P20
L20
P38
SS1
SS3
P42
WS1
WS2
SR
P36
L30
P13
OP
CT1-SEE NOTE 1
CT2-SEE NOTE 2
CT3-SEE NOTE 3
P39
FL1
FL2
FP1
FP2
P44
P37
L5
TR1
TR2
TR3
P1
J1
K3
SH1
K2
S1
S2
S4
CB1
S9
S8
R2
M1
M2
M3
M4
M5
M6
M8
M9
DS1
DS2
DS3
TB1
K1
K5
K8
CONTROL BOX

NOTES:

1. WIRES NUMBERED X1B10A-CB2-A AND X1C10A-CB2-A TAKE TWO TURNS GOING THROUGH CT1.
2. WIRES NUMBERED X2B10B-CB2-B AND X2C10B-CB2-B TAKE TWO TURNS GOING THROUGH CT2.
3. WIRES NUMBERED X3B10C-CB2-C AND X3C10C-CB2-C TAKE TWO TURNS GOING THROUGH CT3.
4. FOR INTERPRETATION OF:
   ABBREVIATIONS SEE MIL-STD-12.
   ELECTRICAL SYMBOLS SEE MIL-STD-15.
   MARKING OF ELECTRICAL LEADS SEE MIL-W-5088.

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Figure 57. Wiring diagram.